Your Name_____Team Name: _____ Per: ____

NEWTON SCOOTERS

Key Question: How do the laws of physics apply to moving vehicles?

In this project, you will use Newton's three laws of motion and other concepts of physics to design and power a vehicle. This vehicle must travel forward *at least* **five feet** and be self-propelled (without an outside force).

Starting the Project

- You may work alone or in a group of 2-3 students.
- Choose a name for your design team.
- Your group will build a vehicle that can travel over land or by air (like a hover craft).
    - Your vehicle can be decorated to match your team's chosen name. Creativity counts!
- You and your partners will use the Internet, expert advice, and/or books, to research ideas for the type of car you will design and build. You will be sharing your concept car and displaying a poster during your presentation.

Scooter Rules and Guidelines

- Your vehicle must travel forward a minimum of **five feet** and completely cross the finish line. The path of your vehicle must stay within a **width of 3 feet.** Your car should travel in a straight path.
- You must build your vehicle from scrap materials. No ready-made cars, wheels, or car parts allowed.
- You may not interfere with the vehicle's movement.
- You cannot use any form of electricity or pull of gravity (no batteries or ramps).
- The following items are prohibited:
    - Remote controls vehicles
    - Store-bought projects
    - Batteries
    - Ramps
    - CO^2 cartridges, explosives
    - Fire
    - **Do Not** make your car completely from a kit; like legos or knex.

Starting your Research

Methods to Consider:

- Spring-loaded design – Spring pushes against a surface and sends the vehicle forward
- Inflated balloon – Air released from the balloon creates forward motion
- Rubber band – release of tension sends the vehicle forward
- Winding wheels – Unwinding causes forward motion of wheels
- Mousetrap- force from the spring sends car forward
- Clothespin springs
- Propellers
- There are others. You come up with a new method!

Suggested Material:

You can use recycled materials from home for your project:

• Toys	• Springs
• Bottle caps	• Straws
• CD's	• Bamboo skewers
• Dowels	• Fishing line
• Craft wood	• Paper towel rolls
• Building blocks	• Mouse traps
• Balloons	• Propellers
• Records	• Bottles
• Rubber bands	• Etc.!

Be creative and have fun! You don't have to limit yourself to vehicles with wheels. Think of other ways to make your vehicle move five feet while staying within a width of 3 feet.

1. Planning, Research and Design

a. Research three different types of propelled cars to help you decide on the type of vehicle you want to build.
b. **All** group members record research and sources on the **Research** page of their Newton Scooter packet.
c. Once you have an idea of what type of propelled vehicle you are going to build, start to sketch a design of your car. You should keep the following items in mind while planning your design:
    - **You must be able to explain how Newton's 3 laws apply/help you design, build, and move your vehicle.**
    - **Consider all the types of friction and how you can deal with them.**
    - **What forces apply to your design?**

d. Your vehicle design plans must be approved before you begin construction of your vehicle.
e. The final Scooter design should be displayed on your poster. (see Poster rubric for requirements.)

Building & Testing your Vehicle

2. Once your research and planning is complete and approved, begin to build your scooter.

a. Review requirements for materials that can be used.
b. Build car according to your proposal (keep in mind that you will probably make changes to your original design)
c. Test your vehicle **at least two times** for distance and a straight path.
d. Complete page **Scooter Testing and Design** in this Newton Scooter packet.
e. Troubleshooting your vehicle
    i. Does your car not travel in a straight line? Check the alignments of the axles.
    ii. Do your wheels wobble? How can you fix them if they do?
    iii. Are there any parts encountering friction? Do you want that to occur?

Presentation & Poster

3. For the presentation, you will explain your poster and vehicle to the class (see rubric for poster design and presentation details). Each member must take part in the presentation.

a. You must introduce your team, and discuss the items from your poster with the class. Refer to the rubric for a complete list of requirements for the poster.
b. Final design must be included in complete detail with labels and materials used.
c. Forces that act on scooter (friction, gravity)
d. Newton's 3 laws and how they were applied in the design

Race Day

You will have 3 attempts to get your vehicle to cross the finish line. The team from each class whose vehicle goes the farthest and meets all of the requirements will be invited to a pizza party.

Tasks & Grading Sheet

Task	Points	Due
Scooter Research 1. Three different ideas **2.** Sources	**__/10**	
Scooter Proposal 1. Explanation of how Newton's laws and friction apply to your vehicle 2. A detailed drawing, including parts and materials labeled	**__/20**	
Scooter Testing and Design Test your vehicle at least twice and complete *Scooter Testing and Design* page	**__/20**	
Poster • **Vehicle Sketch is included**: The vehicle is well-drawn and labeled with all criteria included (you can include a picture of your vehicle and your team) • **Newton's 1st Law**: described in red, and there is a red arrow pointing to what part of the vehicle will overcome the inertia • **Newton's 2nd Law**: described in blue, F=ma is written, and there is a blue arrow pointing to what part of the vehicle provides force to overcome mass • **Newton's 3rd Law**: described in green. There is a green arrow pointing behind your vehicle labeled "Action" to show the force. There is a green arrow labeled "Reaction/Motion" pointing the opposite direction at the front of your vehicle • **Friction Forces**: Identify 2 sets of frictional forces. Vector arrows drawn and labeled in orange. The arrows are drawn horizontally, facing the direction *opposite* motion, and pointing to the part of the vehicle that experiences the friction. • **Other Forces**: Identify other forces that affect your vehicle, draw vector arrows *and* label in orange. • **Creativity:** Your team's name is creatively drawn at the top in LARGE letters. The poster is decorated to match your team name and the vehicle.	**__/20**	
RACE Day • Car travels at least five feet and within 3 foot width	**__/20**	
Total for Team	**__/90**	
Individual Team Member Evaluation What percentage did you participate in your teams project? Be Honest! I will ask all team members for their opinions.	**__/10**	
(Total for Each Member (including Team pts)	**__/100**	

Scooter Research

Directions: Research three different types of propelled cars. List the sources you use, and describe the pros and cons of each type of car.

Methods to Consider:

- Spring-loaded design – Spring pushes against a surface and sends the vehicle forward
- Inflated balloon – Air released from the balloon creates forward motion
- Rubber band – release of tension sends the vehicle forward
- Winding wheels – Unwinding causes forward motion of wheels
- Mousetrap- force from the spring sends car forward
- Clothespin springs
- Propellers

Method 1: _____

Pros:

Cons:

Source used:

Method 2: _____

Pros:

Cons:

Source used:

Method 3: _____

Pros:

Cons:

Source used:

Design/Materials

1. Draw a sketch of your vehicle following all the criteria:
Teacher initials_____ Date_____

List your materials:

_____

_____

_____

Newton's Laws and Friction

Explain how Newton's three laws apply to your vehicle:

1st law:

2nd law:

3rd law:

Explain how you took into account friction (the good and the bad):

Scooter Testing and Design

Date of Test 1: _____

Did your vehicle pass your test/ did it make it 5 feet? _____

How far did it go? Measure the distance and write record it here: _____

Calculate its speed (s=d/t)_____

What changes do you plan to make to improve your vehicle's speed and/or distance?

_____

_____

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_____

_____

_____

Date of Test 2: _____

Did your vehicle pass your test/ did it make it 5 feet? _____

How far did it go? Measure the distance and write record it here: _____

Calculate its speed (s=d/t)_____

What changes do you plan to make to improve your vehicle's speed and/or distance?

_____

_____

_____

_____

_____

_____

Team Name _____ Period _____

Poster Rubric

Requirements		Pts.
Vehicle Sketch is included: The vehicle is well-drawn and labeled with all criteria included.		5
Newton's 1st Law: described in red, and there is a red arrow pointing to what part of the vehicle will overcome the inertia		4
Newton's 2nd Law: described in blue, F=ma is written, and there is a blue arrow pointing to what part of the vehicle provides force to overcome mass		4
Newton's 3rd Law: described in green. There is a green arrow pointing behind your vehicle labeled "Action" to show the force. There is a green arrow labeled "Reaction/Motion" pointing the opposite direction at the front of your vehicle		4
Friction Forces: 2 forces of friction vector arrows are drawn *and* labeled in orange. The arrows are drawn horizontally, facing the direction *opposite* motion, and pointing to the part of the vehicle that experiences the friction.		1
Gravity Force: A force of gravity vector arrow is drawn *and* labeled "gravity" in orange. The arrow is drawn vertically and underneath the vehicle.		1
Creativity: Your team's name is creatively drawn at the top in LARGE letters. The poster is decorated to match your team name and the vehicle. All team members' first and last names are written on the front of the poster.		1
Comments:		20

Individual Team Member Evaluation

Your Name: _____

What percentage did you participate in your team's project? What did you do? Be specific and honest!

_____

_____

_____

_____

Team Member: _____

What percentage did this team member participate in your team's project? What did they do? Be specific and honest!

_____

_____

_____

_____

Team Member: _____

What percentage did this team member participate in your team's project? What did they do? Be specific and honest!

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