Gears Educational Systems, LLC

GEARS-EDS . . . technology education in a box

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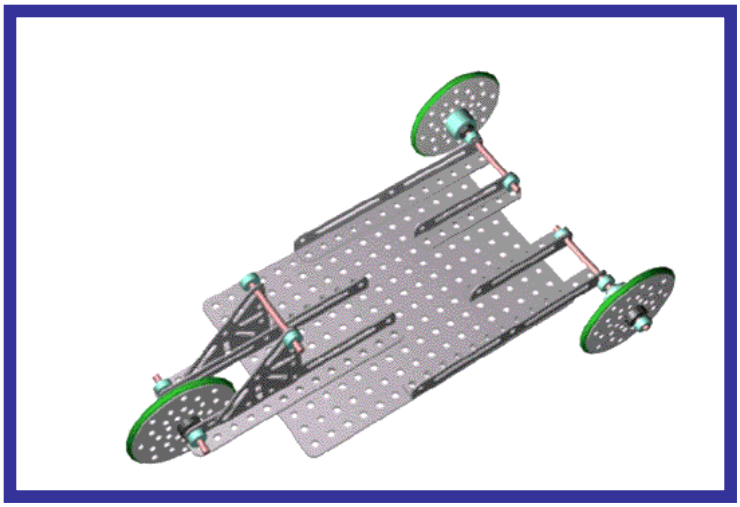
Build Newtons's Cart

Build and Use Newton's Cart to Explore These Engineering and Physics Principles:



DESIGN/BUILD/TEST/ PLAY

Use The GEARS-IDS™ Invention and Design System to create **Apparatuses that help teach the Fundamentals of Physics.** Students and teachers can create and use project based physics demonstrations that help students learn concepts through personal experiences.

Students and teachers who participate in these 4 activities learn the necessary math, science and principals of engineering they need to create competitive machines.

Basic Physics, Mathematical reasoning and the iterative process of experimenting, building, modifying and playing with ideas are the skills needed for a successful introduction to engineering.

Mechanical Principles

- Bearings and Structures

Science and Engineering Principles

- Force Mass and Motion
- Work
- Friction
- F=ma and Newton's Laws of Motion
- Testing and Analysis

Design Principles

- Subassemblies and Components
- Linkages and Power Transfer
- Rigidity and Structures
- Threaded Fasteners

Mathematics

- Create and Use Basic Mathematical Models to Evaluate and predict Component Performance
- Assess Performance
- Algebraic and Geometric Manipulations

History of Science and Technology

- Physicists and Philosophers like Kepler, Galileo and Newton that contributed to the science of Force and Motion.

Personal and Interpersonal Skills

- Acquires and Evaluates Information
- Allocates and Organizes Time and Materials

NOTE: GEARS-IDS Components can be used to build a multitude of Physical Science Apparatuses. They can be used to explore levers, work power and energy, pendulum motion and a whole lot more.

Building Newton's Cart

Use the GEARS-IDS Components to Verify Newton's 2nd Law

$$F = ma$$

Who Can Engineer a Way to Obtain the Greatest Acceleration of a Given Mass from the Least Weight (Force)?

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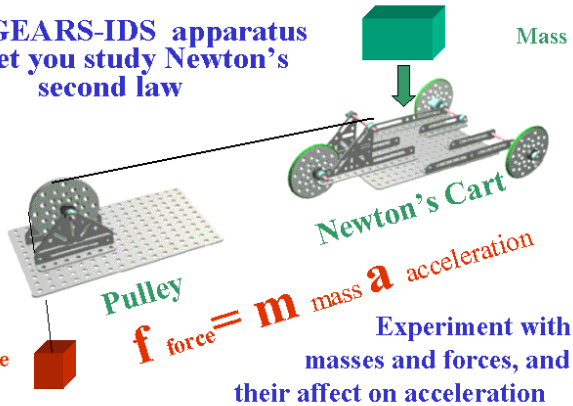
Newton's 2cd Law

This GEARS-IDS apparatus will let you study Newton's second law



$f_{force} = m_{mass}\, a_{acceleration}$

Experiment with masses and forces, and their affect on acceleration

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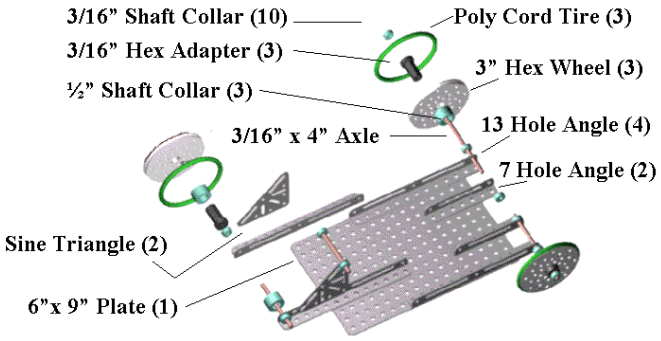
Exploded View of Newton's Cart



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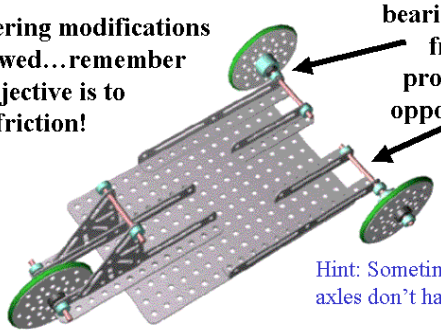
2 Students @ 20 Minutes Assembly Time

Newton's Cart

Engineering modifications are allowed…remember your objective is to reduce friction!

Axles and bearings can be friction problems or opportunities!



Hint: Sometimes the axles don't have to turn!

Be Careful to Strap the Mass on Securely or Inertia Will Cause an Accident!

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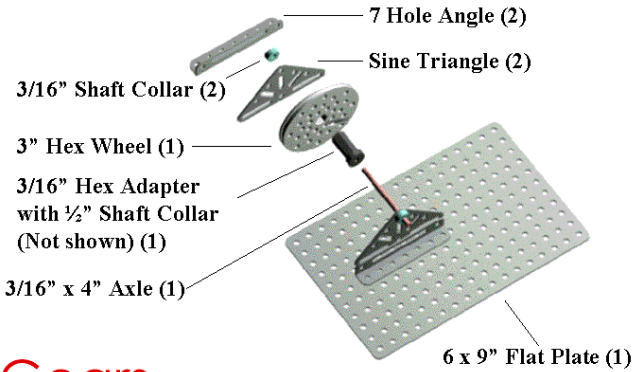
Exploded View of the Pulley



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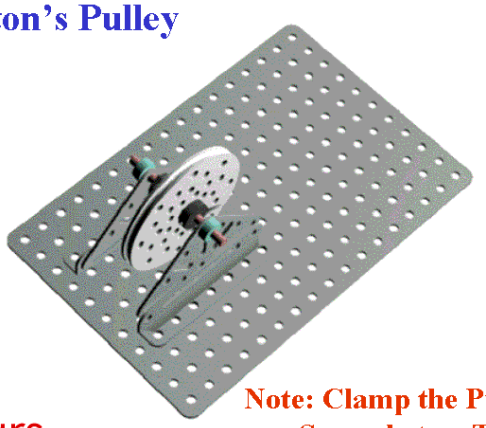
Newton's Pulley



Note: Clamp the Pulley Securely to a Table

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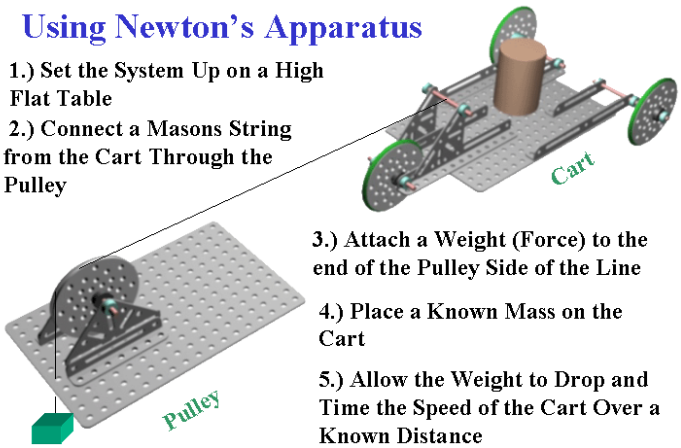
Using Newton's Apparatus

1.) Set the System Up on a High Flat Table

2.) Connect a Masons String from the Cart Through the Pulley



3.) Attach a Weight (Force) to the end of the Pulley Side of the Line

4.) Place a Known Mass on the Cart

5.) Allow the Weight to Drop and Time the Speed of the Cart Over a Known Distance

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Note: Cart and Pulley distance = 2x Table Height. Stop the clock when the weight hits the floor

Calculate the Acceleration of the Cart

Note: This formula will work because the Cart started with a velocity of zero and accelerated at an (approximately) constant rate. In this particular case, the final velocity is the average velocity x 2.

$$C_a = \left(\frac{D}{T}\right) \cdot 2 \Big/ T$$

Where:

C_a= Acceleration of the Cart in meters/sec/sec

D = Distance Covered in meters

T = Time in seconds

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Individual Experimental Data Record for Newtons Cart Activity

Trial	Weight or Force in Kg or lbs.	Total of Mass and Cart in Kg or lbs.	Acceleration in ms^2 or fps^2
1.)			
2.)			
3.)			
4.)			
5.)			

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Note: A class can elect to use either unit system, but be consistent. NEVER MIX UNITS!