Human Dynamics Cart

P3-3617

INSTRUCTIONAL GUIDE

Contents

- Cart Base
- 4 Wheels
- 16 ¼'' x ¼'' Bolts
- ¼'' Lockwasher
- ¼'' Nut

Recommended for activities:

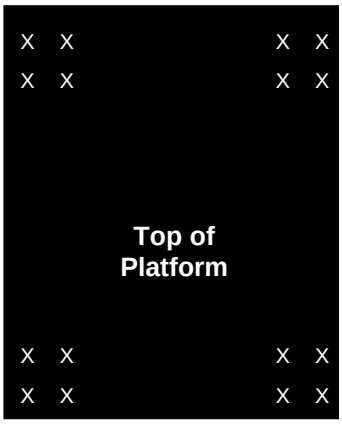
- Rope
- Medicine ball or sand bag
- Spring scale

Background

The Human Dynamics Cart is a platform mounted on four low-friction wheels, the Human Dynamics Cart allows students to become part of the experiment or demonstration.

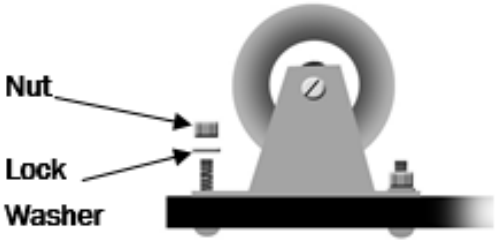
Assembly

- Locate the four groups of pre-drilled holes in each of the corners of the cart platform.



- From the top of the platform (Black side) insert the attachment bolts supplied with your Dynamics Cart. The holes have a tight tolerance so do not force the bolts if they are too tight to go through. Do not use a hammer to drive them through. This can damage the laminate surfaces. Simply use a screw driver to screw the bolts down into place.

- After the bolts are inserted into the platform, turn the platform over so the bottom side (Brown side) is facing up. Place the four wheel assemblies into position over the protruding bolts. Axel nuts should be facing toward the inside of the cart. On each of the protruding bolts attach a lock washer and then the nut. Do not tighten yet.



After the wheel assembly bolts have been installed, each wheel must be secured for alignment.

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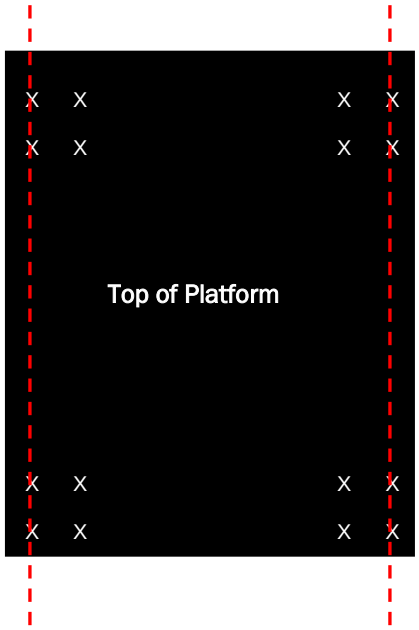
Wheels must be properly aligned for maximum performance.



Your cart platform has been pre-drilled with the outside bolts placed in parallel lines, as illustrated by the dotted lines in the figure to the left.

- Using the outside bolt holes as a reference for being straight, push the wheel assembly towards the inside of the platform to align the wheels to be parallel. It is helpful to place a straight edge along the outside edge of the wheel assembly frames on each side of the cart, similar to the dotted lines in the figure.
- Tighten each of the four bolts until snug.
- Repeat this process at each wheel assembly location.

Push wheel assembly in, against the outside bolts as you tighten the bolt nuts.

Activities

Newton's Second Law

Newton's Second Law, F=ma. If an equal force is applied to objects of different mass, the smaller object will undergo greater acceleration.

1. On one cart, seat a large student. On a second cart, seat a small student. Separate the carts by a distance, at least 10 feet.
2. Give each student one end of a non-stretch rope.
3. Ask the students to pull gently on the rope, causing their carts to move. Who moves farther?

Newton's Third Law

Newton's Third Law, "Equal and Opposite." When an object exerts a force on another object, the second object exerts an equal and opposite force on the first object.

1. Repeat the setup in the last experiment, with one student on each cart.
2. Connect a spring scale or force sensor to each end of the rope.
3. Ask students to report the force they see measured on their scales while they pull. The forces should be approximately equal, regardless of the mass on the cart.
4. Single-cart variation: Connect the second scale to an immovable object. When the student pulls her/him-self toward the object, both scales will still be approximately equal.

Momentum and Collisions

1. Seat one student on a single cart.
2. Toss a heavy object, such as a sandbag or medicine ball, to the student.
3. When the student catches the object, the cart will move in the original direction of the throw.

Momentum and Explosions

1. Seat one student on a single cart, with a heavy object such as a sandbag or medicine ball.
2. Ask the student to throw the object away, and observe the recoil of the cart. Experiment with the effect of different weights and throwing speeds.

Momentum and Rocket Engines

Many students believe that rockets “push off of the ground” on launch. Correct the misconception with this advanced demonstration that uses a fire extinguisher.

Important: This demo should only be done by an adult wearing a safety helmet and eye protection. Use only a CO2 fire extinguisher in a ventilated area. Contact a professional to help you remove the nozzle from the extinguisher and use it safely in this context.

1. Arrange your demo area to prevent crashes. Use a cushioned landing area or an assistant.
2. Put on safety gear. Sit on the cart. Hold the extinguisher firmly.
3. Release gas from the fire extinguisher, and observe the cart’s acceleration in the opposite direction.

Related Products

Dynamics Carts (pair) (P3-3530) High-impact plastic carts for any mechanics experiment involving linear motion. Designed to accommodate our liquid accelerometer or up to five ordinary bricks as test masses. One cart includes a spring-loaded plunger.

Rotating Platform (P3-3510) The Rotating Platform can be used with hand weights to study rotational inertia, conservation of angular momentum, and action-reaction. Diameter 40cm

Liquid Accelerometer (P3-3525) Add colored water to this Liquid Accelerometer and align it with linear or centripetal acceleration. The water creates a line graph in response to the acceleration.

Newton Scale (PX-1090) The Newton Scale is a great tool to use when determining the differences and similarities between mass and weight.