Overview: Fancart 3-way Activity

This example activity downloaded from PhysPort:
www.physport.org/methods/SCALE_UP

The other parts of this activity, along with more activities like this, can be downloaded from the SCALE-UP members only page:
https://scaleupserver.physics.ncsu.edu/wiki/pages/f6A0j011/Tangible:_Fancart_3-way_Activity.html

This is an activity for a SCALE-UP classroom where 3 groups of 3 students sit at each large round table. In this activity, each group does a different activity on the same topic, 1-dimensional acceleration. One group does an experiment with a physical fan cart, another group analyzes a video, and the third group writes a simulation in VPython. After completing the first round of activities, the groups rotate so that each group does all three activities. Because the groups learn from each other, the activities take less time in subsequent rounds. This type of activity is useful for saving money/space on equipment - you only need one set of equipment for every 9 students, and while some students use equipment that takes up a lot of table space, other students can work on a laptop.

Tangible: Fancart 3-way Activity

There are three parts to this lab (see details below). Each group must do all three.

Initially:
If you are in an "a" group, do “Lab: Fan Cart motion”
If you are in a "b" group, do “Lab: Fan Cart movie analysis”
If you are in a "c" group, do “VPython: Modeling Motion”

Once you have completed your group's part, switch to another, then another.

Lab: Fan Cart motion

WID 1074677

Previously, you made predictions about the graph of the x-component of position vs time and momentum vs time for a cart on a track in cases of fan off, fan force in +x dir, and fan force in –x direction (Activity – Predict this). Now, you are actually going to do the experiment, using a motion detector that records the position of the moving object. The data from the motion detector is fed into a handheld Vernier LabQuest device.

Note the devices need to be connected to the motion detector, and the AC power adaptor needs to be plugged in too (didn’t have time to charge the batteries).

On tables, tracks with fan cart in center of table. Each group will record x vs t and v_x vs t for the three situations where you made predictions (Activity – Predict this!). Make plots on the LabQuest screen. Each group makes these measurements. Be ready to help other groups if they are having trouble using the equipment.

As you gather the plots, think and discuss with your group: Do these measurements match your predictions?

Let's discuss—how did your measured graphs differ from predictions? (Discuss in particular transients at beginning and end while your hand touches the cart. Note for the no fan case, the velocity isn't constant—why? And what about the fan opposing initial v case? Any difference in graph for first half vs. second half?)

Reason for difference in first vs. second half—draw the directions of the forces acting on the cart for first half and second half. Come up with a way to calculate the frictional force on the cart based on the data you've collected. (Hint: You'll need the momentum principle! Hint: You'll need the mass of the fan cart!)

You can convert velocity data to momentum data directly on LabQuest. Also, you can measure the slope of the graph.

Lab: Fan Cart movie analysis

WID 1074679

Fan Cart Videos - Data.xls

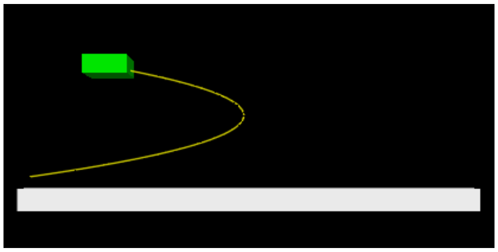
Video analysis.pdf

For the three situations where you made predictions (Activity – Predict this!), use Excel data (or LoggerPro video analysis) to plot x vs. t and p_x vs. t and then compare to your predictions. Instructions in WebAssign.

VPython: Modeling Motion

WID 1070724 VPython: Modeling Motion

fancart.py



You've analyzed this problem with theory (momentum principle) and experiment. There is a third way to tackle scientific problems—computer modeling.

You will create a VPython model of this system. This will introduce you to using VPython to model motion (rather than just create static scenes as we did previously).

Open the WebAssign. Link to the instructions are there.

Checking Questions:

• Which statement represents the position update formula?
    Note: Position update should always go after momentum principle

• Which statement represents the Momentum Principle?

• What would you have to change in your program to make the cart start at the right end of the track and move to the left? Initial position and initial velocity

• Should the Momentum Principle statement be placed before the loop or inside the loop? Why? Inside the loop

• What happens when the initial momentum of the fancart includes a +y component?

Lab: Momentum and Momentum Change

Alternate Lab (using DataStudio)
(replacing Fan Cart motion and Fan Cart movie analysis):
WID 624955