Force Data Protocols

Safety Protocols

When working with the lab materials, the following safety precautions are necessary.

- Only conduct the activity under the supervision of qualified personnel who can respond quickly to any unforeseen circumstances.
- Students involved in setting up the equipment and conducting the experiment must be properly trained in handling the sensor carts and understand the experimental procedures.
- Wear appropriate personal protective equipment (PPE) including sanitized safety glasses with side shields during the setup, experimentation, and takedown segments of the activities.
- Secure loose clothing, wear closed-toe shoes, and tie back long hair.
- Use caution when using sharps (tools, etc.), which can cut or puncture skin.
- Clear the workspace of any obstacles or hazards that could interfere with the experiment or cause accidents during the collision.
- Make sure that all parts of the carts are properly secured and stabilized before conducting the collision test. Follow manufacturer guidelines for setup and operation.
- Immediately clean up anything that falls on the floor, so it does not become a slip or fall hazard.
- Maintain a safe distance from the collision area during the activity to avoid injury from flying debris or malfunctioning equipment.
- Following the activity, inspect all equipment for any damage or wear and tear. Report any damage to the instructor so any damaged components can be repaired or replaced before further use.
- Wash hands with soap and water once all equipment is put in appropriate storage areas.

Materials

- sanitized safety glasses with side shields
- variable force cart (prefilled with gravel/sand)
- braking washers
- tumble buggy with spring scale
- ramp setup with brake release block
- stopwatch
- computer with access to https://codap.concord.org/app/static/dg/en/cert/index.html

Force Adjustment and Measurement Protocol

Changing braking force

All the braking washers should initially be placed on the cart, split between the 2 bolts. To increase the braking force, move washers from the top bolt onto the brake bolt. To decrease the braking force, move washers from the brake bolt to the top bolt.



Measuring braking force

To measure the braking force, place the cart on the flat part of the ramp and hook it to the spring scale on the tumble buggy. Turn on the tumble buggy so it drags the cart along the flat part of the ramp. The brake should be engaged. Read the force on the spring scale while the tumble buggy drags the cart. Record this force on your *Braking Investigation* handout.



Cart Release Protocol

1: Position the cart on the ramp, making sure the front of the cart is aligned with the tape on the ramp that shows the starting point.	Front of cart aligned with tape
2: Place the brake trigger under the brake and place the slack of the string on the ramp behind the cart. Note: The brake trigger should release the brake when the cart reaches the bottom of the ramp. If the string gets caught on anything (such as the ramp) when the cart is released from the starting point, the brake will engage early and the timing data will be off. If you notice that the string got caught, redo that trial.	<image/>
3: Once the person who is timing is ready, release the cart. Watch to make sure the brake releases correctly when the cart reaches the bottom of the ramp.	

Time Measurement Protocol

Hand timing: The person timing needs to let the person releasing the cart know when they are ready to time. Then have the other person release the cart. At the moment when the cart reaches the bottom of the ramp and the brake engages, start the stopwatch. Stop the stopwatch as soon as the cart comes to a full stop. To enhance accuracy, consider conducting multiple trials for each condition. Record the times on your *Braking Investigation* handout.

CODAP Graphing Protocol

1: Open CODAP

Open your web browser and type in the CODAP website's address:

https://codap.concord.org/app/static/dg/en/cert/index.html







7: Input your data To add data to your table, double-click on the appropriate cell and type in the value you recorded. Then press the "Enter" key	Tables Image: Sider Image
You can resize the table by clicking and dragging its bottom right corner.	2 20 8.7 3 30 103 4 40 125
	Images generated using CODAP (https://codap.concord.org/), developed at the Concord Consortium.
	Independent Variable and Braking Time Investigation
	Images generated using CODAP (https://codap.concord.org/), developed at the Concord Consortium.



