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NEWTON'S 3RD LAW MINI- LAB

PART I – FORCE SENSORS

Purpose: *To observe the directional relationship between 3rd law force pairs.*

Materials:

- Lab Quest
- 2 Force Sensors
- String
- Rubber Band

Procedure:

1. Connect the Force Sensors to Channels 1 and 2 on the LabQuest device. Set the range switch to 50 N.
2. Click on the colored boxes that show the reading of the force sensors and select "Zero" from the menu that appears. If the sensor doesn't zero, call your teacher over to help calibrate the sensors.
3. Pull on each of the force sensors to figure out which direction is the positive direction. Record the results.
4. Make a short loop of string with a circumference of about 30 cm. Use it to attach the hooks of the Force Sensors. Hold one Force Sensor in your hand and have your partner hold the other so you can pull on each other using the string as an intermediary.

5. Gently tug on your partner's Force Sensor with your Force Sensor, making sure the graph does not go off scale. Also, have your partner tug on your sensor. You will have 10 seconds to try different pulls.
6. What would happen if you used the rubber band instead of the string? Would some of the force get "used up" in stretching the band? Repeat Steps 3–4 using the rubber band instead of the string.

Analysis Questions:

1. What can you conclude about the two forces (your pull on your partner and your partner's pull on you)? How are the magnitudes related? How are the signs related?
2. How does the rubber band change the results—or does it change them at all?
3. Is there any way to pull on your partner's Force Sensor without your partner's Force Sensor pulling back?

PART II – FORCE PLATES

Purpose: *To investigate the effect of Newton's 3rd Law when applying a push force.*

Materials: (*new materials needed)

- Lab Quest
- 2 Force Plates*

Procedure:

1. Connect both force plates to your LabQuest through Channels 1 and 2.
2. Click on the colored boxes that show the reading of the force plates and select "Zero" from the menu that appears. If the sensor doesn't zero, call your teacher over to help calibrate the force plates.
3. Use the force plates to test the following scenarios:
   a. Person A and Person B have equal mass. They push on each other, but neither moves.
   b. Person B gets tired, and Person A starts to push Person B backward.
   c. Person C is more massive than Person B. They push on each other, and start to move in the direction of Person B.
   d. A person pushes against a stationary wall.

Analysis Questions:

1. For each of the situations from the lab, draw the forces involved. The length of the vector (arrow) should indicate the magnitude of the force, and the direction of the vector should indicate the direction of the force. Label each force in the manner, "A on B" or "B on A."
2. What can you say was *always* true about the two forces, regardless of the scenario?

PART III – ONLINE CONCEPTUAL PROGRESS CHECK

Purpose: *To investigate the effect of Newton's 3rd Law when applying a push force.*

Materials: (*new materials needed)

- Laptop*
- Journal*

Procedure/Analysis Questions:

1. Navigate to my website → Useful Physics Links → The Physics Classroom → Physics Tutorials → Newton's Laws → Lesson 4: Newton's Third Law of Motion

2. **Lesson 4a: Newton's Third Law:**
   a. Skim the information on this page. Make note of any clarifying ideas that you come across in your journal.
   b. Answer the **Check Your Understanding** questions in your journal.

3. **Lesson 4b: Identifying Action and Reaction Force Pairs**
   a. Answer the example questions in your journal.
   b. Answer the **Check Your Understanding** questions in your journal.

4. **WebAssign HW #10: Newton's 3rd Law**
   a. When you're finished, work on WebAssign HW #10 that's due this week.