Gizmos

Name: _____ Date: _____

# Student Exploration: Force and Fan Carts

**Vocabulary**: force, friction, position, speed

**Prior Knowledge Questions** (Do these BEFORE using the Gizmo.)

1. If you are pushing a shopping cart and you start pushing harder, what happens?

   _____

2. What happens to a shopping cart if you get it rolling and then release it?

   _____

**Gizmo Warm-up**

1. In the Gizmo, turn the **Fan force** to **Off**. Click **Play** ( ). Did the cart move? _____

2. Click **Reset** ( ). Press the **Low** fan force button to turn on the fan. Click **Play**. What happened?

   _____


3. A **force** is something that causes change in motion. What provided the force that made the cart speed up?

   _____

4. The speedometer shows the cart's **speed**, or how fast it moves. A speed of 30 cm per second means the cart moves 30 cm every second. What was the final speed of the cart?

   _____

5. **Friction** is a force that works against motion as surfaces rub each other. Click **Reset**. Select the **No Friction** surface. Click **Play**. What was the final speed this time?

   _____

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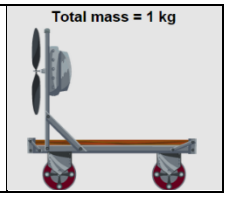
| **Activity A:**<br>**Force and motion** | Get the Gizmo ready:<br>• Click **Reset**.<br>• Change the **Surface** to **Wood**.<br>• Be sure there are no objects on the cart.<br>• The **Fan force** should be set to **Low**. |  |

**Question: How does force affect motion?**

1. Run Gizmo: Press **Play**. What was the final speed of the cart? _____

2. Predict: Would the cart's final speed be higher or lower if the fan were set to **Medium** instead of **Low**? _____

3. Experiment: Click **Reset**. Change **Fan force** to **Medium**. Click **Play**.

   What was the cart's final speed? _____

4. Draw conclusion: Did the cart speed up more quickly with the fan on **Low** or **Medium**?

   _____

5. Generalize: On **Medium** the fan provides more force than on **Low**. Make two rules by filling in the blanks below. (Put the same word in both blanks.)

   *Force causes the _____ of the cart to change.*

   *If more force is used, the _____ of the cart changes more quickly.*

6. Predict: Select the DATA tab. Choose **Bar graph** or **Line graph**. This graph shows the cart speed over time. How would the graph be different if the fan were on **High**? Why?

   _____

   _____

7. Test: Check your prediction with the Gizmo. What do you observe? _____

   _____

8. Extend: Design an experiment to test the effect of force on a loaded cart. You can choose any surface and any object to load onto the cart. On the back of this sheet or an additional sheet, report your question, prediction, procedure, observations, and conclusion.

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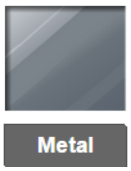
|---|---|---|
| **Activity B:**<br>**Running out of steam?** | Get the Gizmo ready:<br>• Click **Reset**. |  |

**Question: Why do objects slow down when there is nothing pushing them?**

1. Observe: Use the Gizmo to explore the question above. Try different objects and surfaces. Each time, turn the fan force **Off** while the cart is moving. (You may find it helpful to pause the Gizmo with the **Pause** (⏸) button, turn the fan off, and then click **Play** to restart.)

2. Form hypothesis: What causes an object to slow down after no longer being pushed?

   _____

3. Predict: Set **Fan force** to **High**. Based on your hypothesis, circle *all* surfaces that will cause a moving cart to slow down after the fan is turned off. (You may circle more than one.)

   No Friction  Metal  Cement  Wood

4. Test: Run the trials using the Gizmo. Which surface(s) caused the cart to slow down?

   No Friction  Metal  Cement  Wood

5. Draw conclusion: What causes objects to slow down when they are no longer pushed?

   _____

6. Think about it: Imagine the track in the Gizmo went on forever. If there were no friction, how long would it take the cart to stop after you turned off the fan? Explain.

   _____

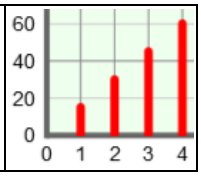
   _____

   _____

7. Analyze: Which surface in the Gizmo has the most friction? Explain how you can tell.

   _____

   _____

| | | |
|---|---|---|
| **Activity C:**<br><br>**Patterns in motion** | Get the Gizmo ready:<br><br>• Click **Reset**. Select **No friction**.<br>• Place only the **soda** and **book** on the cart.<br>• Set the **Fan force** to **High**. |  |

**Question: Are there any patterns in the motion of objects?**

1. Run Gizmo: Be sure **No friction** is selected. Click **Play**. After about 3 seconds, turn the fan **Off**. (We recommend that you click **Pause**, turn the fan off, and then click **Play** to restart the Gizmo.)

2. Observe: Select the DATA tab. Select **Position**. The **position** of the cart is its location (how far from the start line). What pattern do you see in the position data after the fan is off?

   _____

   _____

3. Connect: How is the final speed of the cart related to the pattern in the position data?

   _____

4. Analyze: Why does that pattern happen? (Hint: Think about what "cm per second" means.)

   _____

   _____

5. Observe: Select **Speed**. What pattern do you see in the speed data, after the fan is off?

   _____

   _____

6. Connect: How does the bar graph (or line graph) show the pattern you found?

   _____

   _____

7. Generalize: Fill in the blank below to state a rule based on what you saw.

   *If there is no force, the _____ does not change at all.*