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?

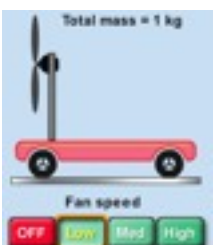
   _____

Gizmo Warm-up

1. In the Gizmo™, turn the fan **Off**. Click **Play** ( ). Did the cart move? _____

2. Click **Reset** ( ). Press the **Low** fan speed 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?

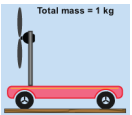
   _____

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?

   _____

Activity A: **Force and motion**	Get the Gizmo ready: • Click **Reset**. • Change the **Surface** to **Wood**. • Be sure there are no objects on the cart. • The **Fan speed** 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 speed** 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 _____ to change.

   If more force is used, the _____ changes more quickly.

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

   _____

   _____

7. Test: Check your previous answer with the Gizmo. Were you correct? If not, explain.

   _____

   _____

Activity B: **Running out of steam?**	Get the Gizmo ready: • 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 **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 speed** 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.

   _____

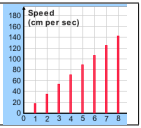
   _____

   _____

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

   _____

   _____

Activity C: **Patterns in motion**	Get the Gizmo ready: • Click **Reset**. • Place only the **soda** and **book** on the cart. • Set the **Fan speed** to **High**. • Select **No Friction**.	

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

1. Run Gizmo: 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 where it is located (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.