

Activity**The Momentum of Colliding Objects****Lab Preview**

Directions: Answer these questions before you begin the Activity.

1. What is Newton's third law of motion?

2. What remains constant in this experiment?

Many scientists hypothesize that dinosaurs became extinct 65 million years ago when an asteroid slammed into Earth. The asteroid's diameter was probably no more than 10 km. Earth's diameter is more than 12,700 km. How could an object that size change Earth's climate enough to cause the extinction of animals that had dominated life on Earth for 140 million years? The asteroid could because it may have been traveling at a velocity of 50 m/s, and had a huge amount of momentum. The combination of an object's velocity and mass will determine how much force it can exert. Explore how mass and velocity determine an object's momentum during this activity.

What You'll Investigate

How do the mass and velocity of a moving object affect its momentum?

Materials

meterstick	softball
racquetball	tennis ball
baseball	stopwatch
masking tape	balance

Goals

- Observe and calculate the momentum of different balls.
- Compare the results of collisions involving different amounts of momentum.

Safety Precautions **Procedure**

1. Use the balance to measure the mass of the racquetball, tennis ball, and baseball. Record these masses in the data table in the Data and Observations section.

2. Use your meterstick to measure a 2-m distance on the floor. Mark this distance with two pieces of masking tape.
3. Place the softball on one piece of tape. Starting from the other piece of tape, slowly roll the racquetball the 2-m distance so it hits the rubber ball squarely.
4. Use a stopwatch to time how long it takes the racquetball to roll the 2-m distance and hit the rubber ball. Record this time in the data table.
5. Measure the distance the racquetball moved the softball. Record this distance in the data table.
6. Repeat steps 3–5, rolling the racquetball quickly.
7. Repeat steps 3–5, rolling the tennis ball quickly, and then slowly.
8. Repeat steps 3–5, rolling the baseball quickly, and then slowly.

Activity (continued)**Data and Observations**

Momentum of Colliding Balls					
Action	Time	Velocity	Mass	Momentum	Distance ball moved softball
1. Racquetball rolled slowly					
2. Racquetball rolled quickly					
3. Tennis ball rolled slowly					
4. Tennis ball rolled quickly					
5. Baseball rolled slowly					
6. Baseball rolled quickly					

Conclude and Apply

- Using the formula $p = mv$, calculate the momentum for each type of ball and action. Record your calculations in the data table.
- Compare the momentums you calculated. Which action had the greatest momentum? Which had the smallest momentum?

- Infer the relationship between the momentum of each ball and the distance the softball was moved.

- Explain why the baseball will have a greater momentum than the tennis ball even if both are traveling with an equal velocity.

- Explain how you observed Newton's third law of motion occurring during this activity.

Communicating Your Data

Use what you have learned about momentum to discuss the differences between the sports of softball and baseball.