

Lift-Off Experiment

Question

How do falcons demonstrate Newton's third law?

Newton's Laws of Motion:

1. An object at rest remains at rest, and an object in motion remains in motion at constant speed and in a straight line unless acted on by an unbalanced force.
2. The acceleration of an object depends on the mass of the object and the amount of force applied.
3. Whenever one object exerts a force on another object, the second object exerts an equal and opposite on the first.

Experiment

Materials

- Materials to make a balloon-powered vehicle
 - Simple vehicle:
 - Cardboard
 - Plastic drinking straws (regular; not extra thick)
 - Wooden skewers
 - Bottle caps (4 per student)
 - Rulers
 - Strong scissors and/or box cutters
 - Awls
 - Tape
 - Glue and/or clay

Instructions

1. Research models for a balloon-powered vehicle and build one.
 - a. Simple vehicle:
 - i. Cut out a rectangle of cardboard (3 x 6 inches).
 - ii. Cut 2 3-inch pieces of a straw.
 - iii. Tape those pieces on the bottom of the piece of cardboard.
 - iv. Cut off the ends of a wooden skewer; then cut 2 4-inch pieces of it.

- v. Slide the skewer pieces into the straw pieces that you taped onto the cardboard previously.
 - vi. Use an awl to poke holes in the centers of 4 bottle caps. You can also use cardboard if you do not have bottle caps.
 - vii. Put the bottle caps on the ends of the skewers. You can use glue or clay on the ends of the skewers so the bottle caps do not slide off.
 - viii. Stick a straw about 2 inches into a balloon (not inflated) and tape the balloon tightly around the straw.
 - ix. Tape the straw lengthwise onto the top of the cardboard. The balloon end should be on top of the cardboard and the other end of the straw should be hanging off the cardboard.
2. Use the straw to blow some air into the balloon, then pinch the straw to prevent air from escaping just yet.
 3. Put the vehicle on a flat surface, and let go of the straw. The vehicle should take off!

Conclusions

The air that rushes out of the balloon backwards pushes the car forwards, in the opposite direction, with equal force. This simulates how birds fly.

Newton's Laws of Motion, as applied to birds:

1. The bird is at rest until it applies force by flapping its wings to start flying.
2. Its acceleration depends on its mass and amount of force applied. With regard to peregrine falcons, this can be demonstrated by its sexual dimorphism: males are smaller than females and do the majority of hunting, because they are able to fly faster after their speedy prey.
3. When the bird's wings flap downwards and backwards, they push the air in that same direction. The air, in turn, provides an equal and opposite reaction, pushing the bird upwards and forwards. (See "lift" in "About Falcons: Flight.")