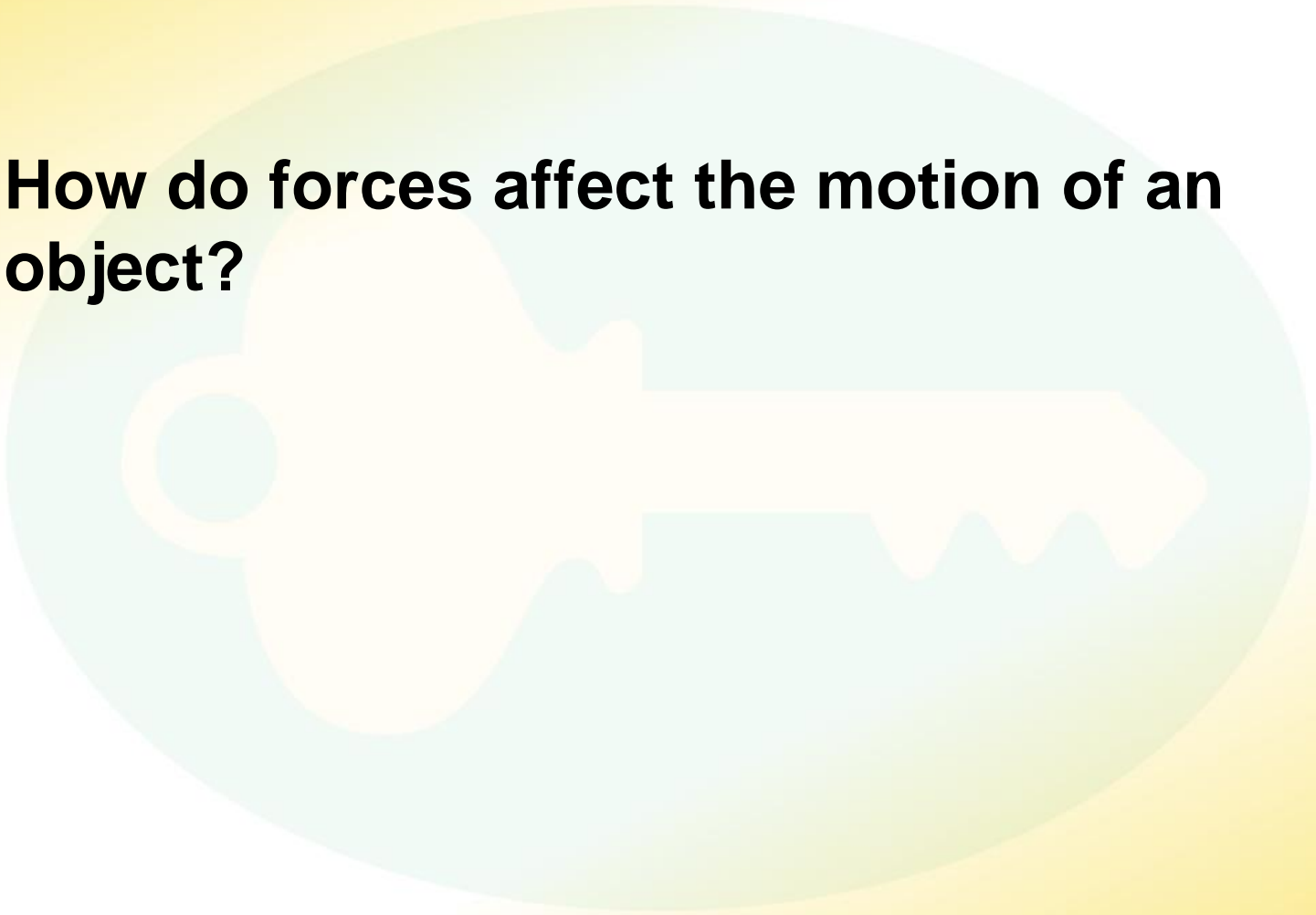


What Is a Force?



How do forces affect the motion of an object?



What Is a Force?

Units of Force

One **newton** (N) is –

12.1 Forces

What Is a Force?

Representing Force

Arrows can represent a force. The lengths of the arrows show relative amounts of force.

DOK question:

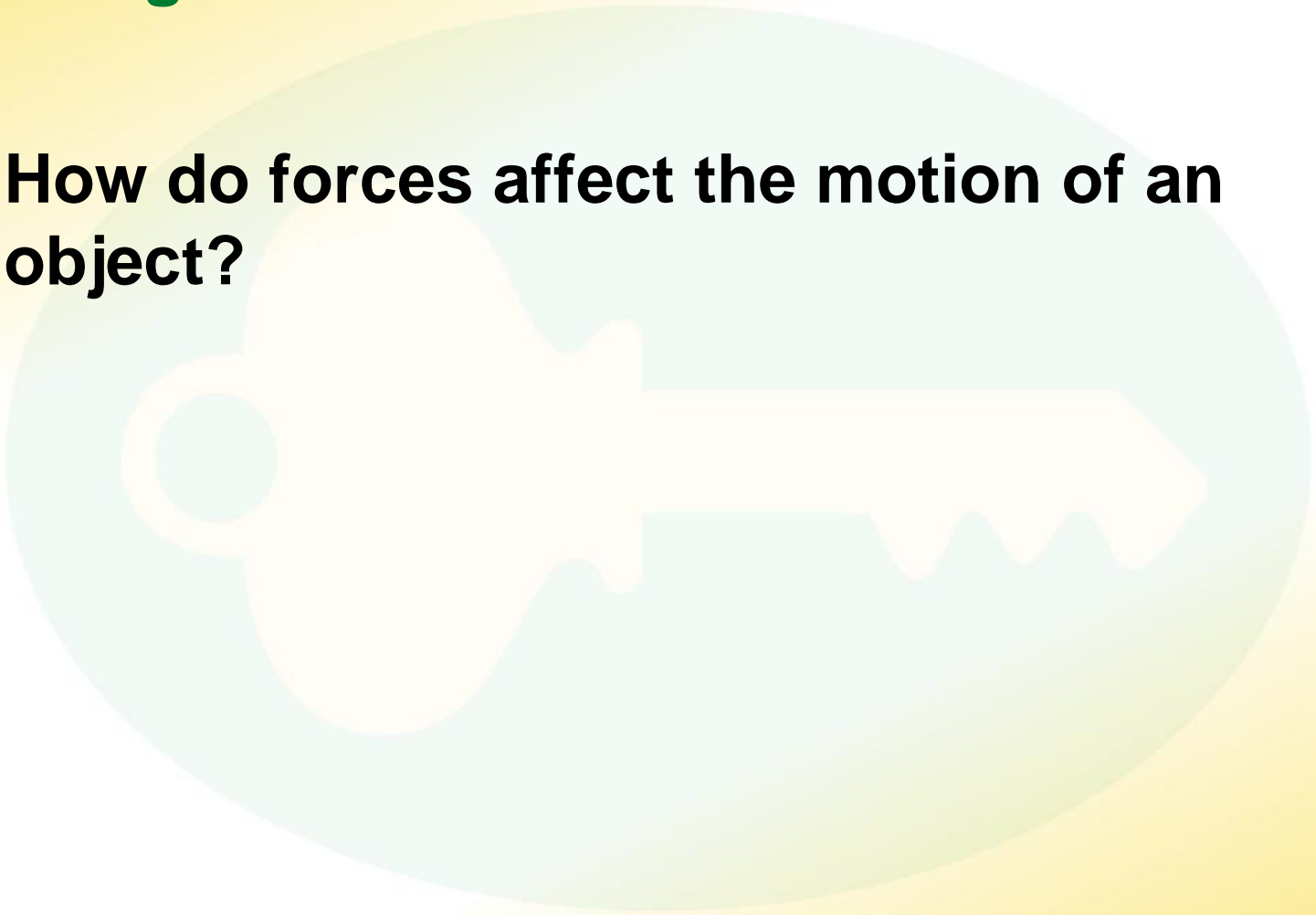
Hypothesize why the vector in the second picture is bigger than the first.



Combining Forces



How do forces affect the motion of an object?



Combining Forces

The **net force** is –

Combining Forces

The two groups pull with equal forces in opposite directions. The forces combine to make a net force of zero.

DOK question:

Describe what could change this outcome.

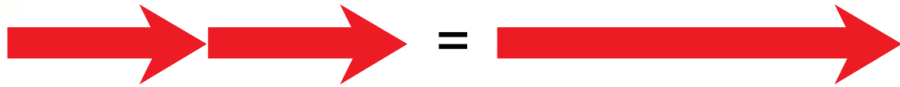


Combining Forces

Forces can add together or subtract from one another.

A

Adding forces

**B**

Subtracting forces

**C**

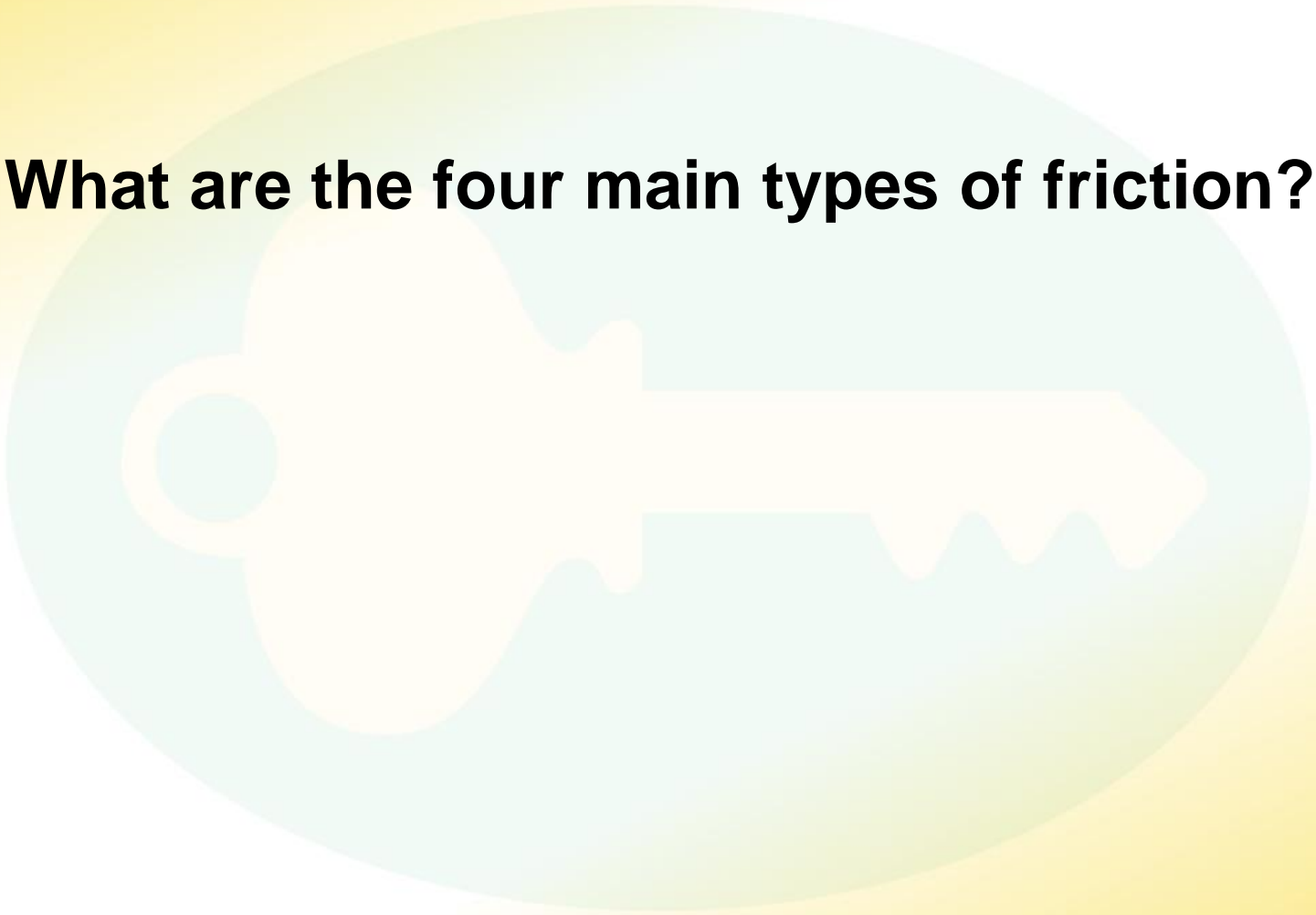
Equal and opposite forces



Friction



What are the four main types of friction?



Friction

Static Friction

Static friction is –

Friction

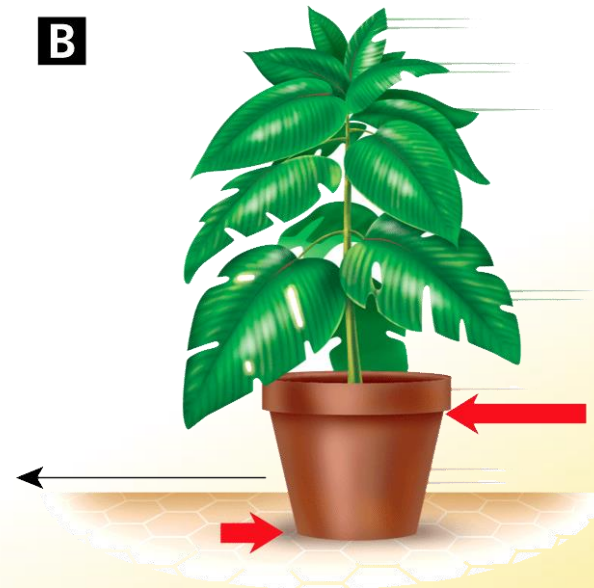
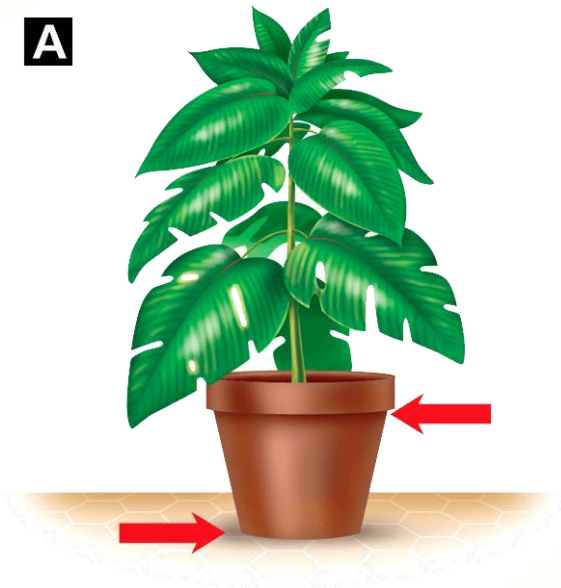
Sliding Friction

Sliding friction is –

Friction

A. Static friction—

B. Sliding friction—



Friction

Rolling Friction

Rolling friction is –

Friction

Fluid Friction

- **Fluid friction –**

- **Air resistance –**

Gravity

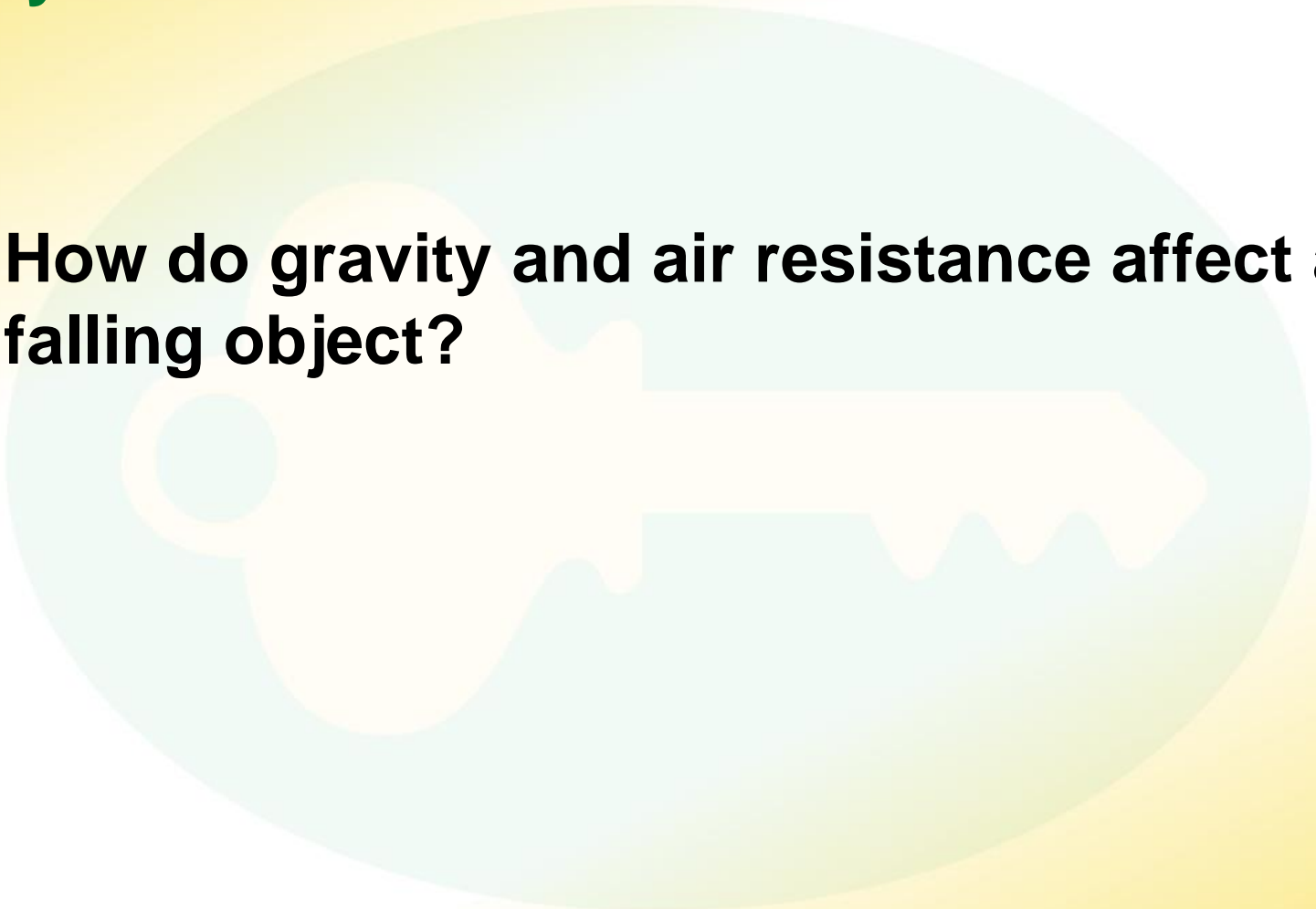


In what direction does Earth's gravity act?

Gravity



How do gravity and air resistance affect a falling object?



Gravity

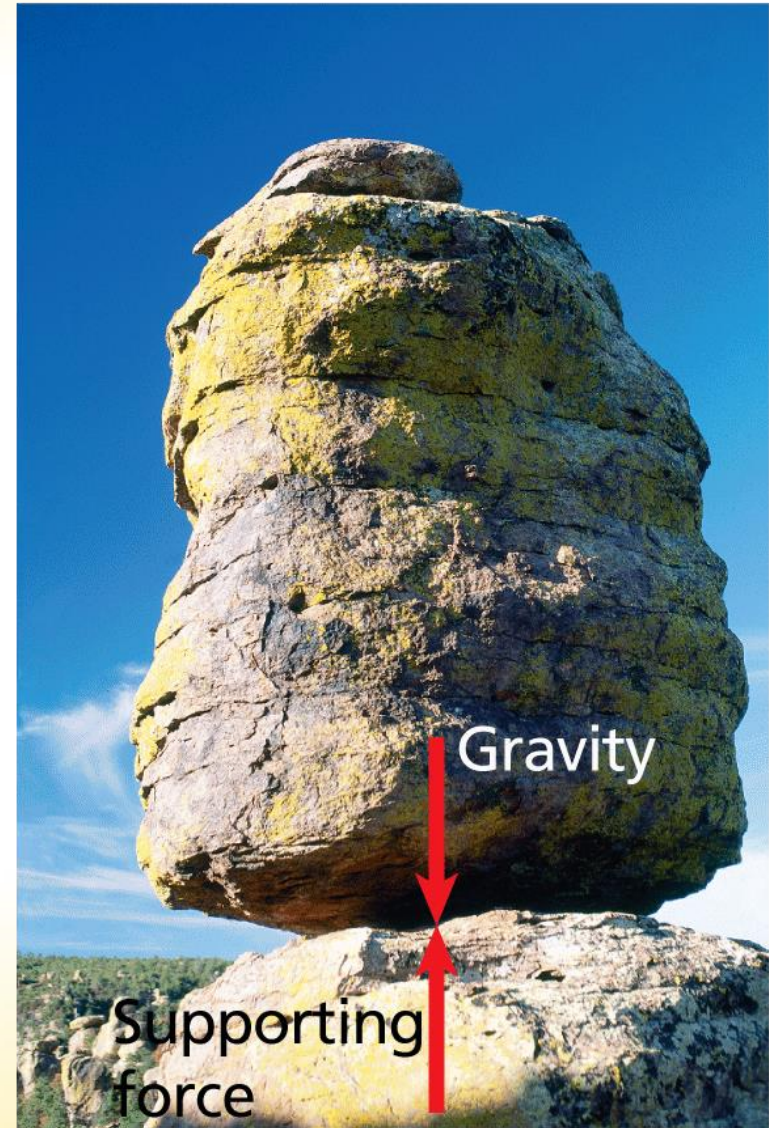
Gravity is –

Gravity

Earth exerts an attractive, downward force on this boulder. The supporting rock exerts an upward force on the boulder. The forces are balanced.

DOK questions:

Hypothesize why this happens.



Gravity

Falling Objects

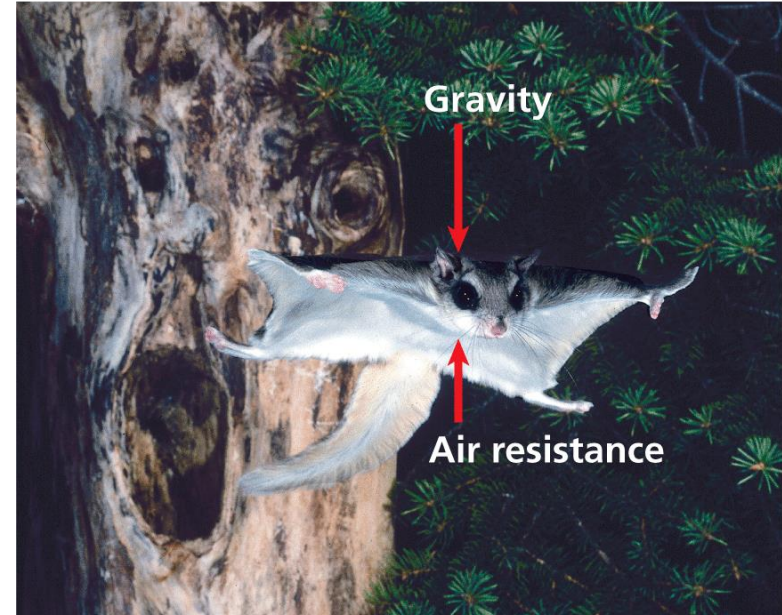
- **Terminal velocity** is –

Gravity

This flying squirrel takes advantage of air resistance to slow its fall and increase the distance covered in the jump.

DOK question:

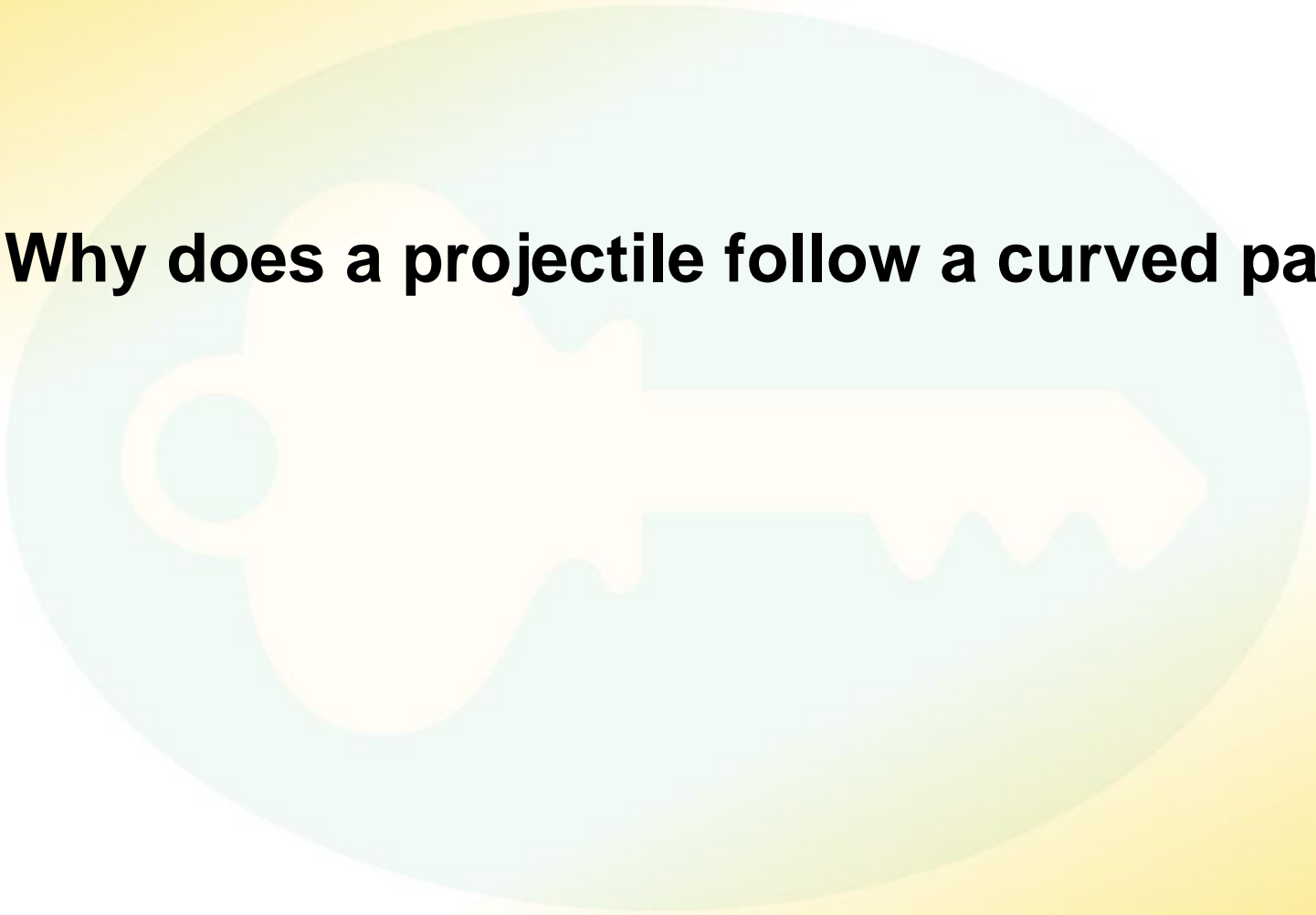
Compare this example with other examples of flight.



Projectile Motion



Why does a projectile follow a curved path?



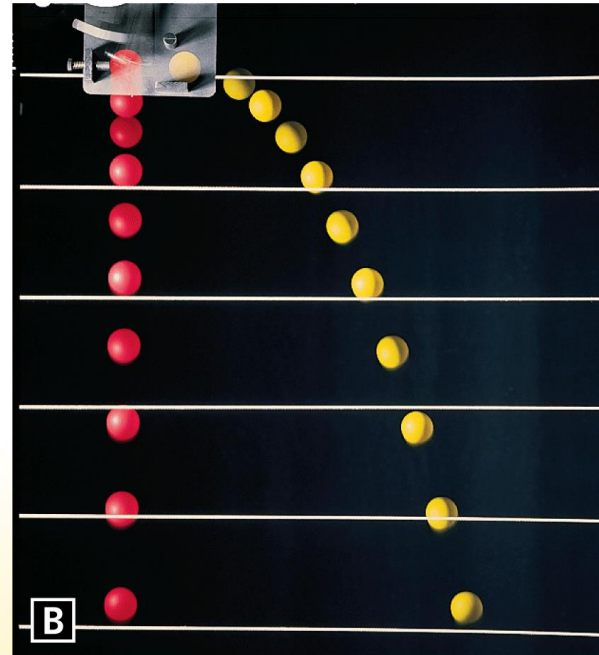
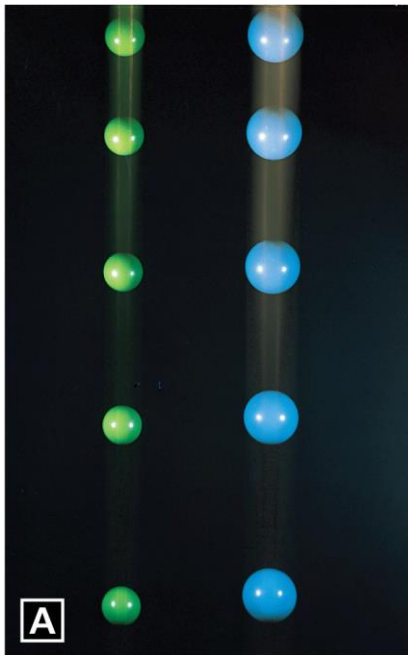
Projectile Motion

A thrown ball follows a curved path.

Projectile motion is –

Projectile Motion

- A. Their masses are different, but the blue and green balls –
- B. The yellow ball is a projectile –



Assessment Questions

1. If an object is at rest, which of the following statements must be true?
 - a. There are no forces acting on the object.
 - b. There is no friction acting on the object.
 - c. The forces acting on the object are unbalanced.
 - d. The net force acting on the object is zero.

Assessment Questions

2. Which of the following is not a type of friction?
- a. static friction
 - b. sliding friction
 - c. fluid friction
 - d. pull friction

Assessment Questions

3. In which direction does Earth's gravitational force act?
- opposite the direction of motion
 - downward toward the center of Earth
 - upward away from the center of Earth
 - in the direction of motion

Assessment Questions

4. A ball thrown into the air follows a projectile course due to the initial velocity and the
- force of gravity.
 - effect of air resistance.
 - motion of Earth beneath it.
 - mass of the ball.

Assessment Questions

1. The SI unit for force is $1 \text{ kg}\cdot\text{m}/\text{s}^2$, also called one kepler.

True

False