EXPLORING MOTION and FORCES Grades 5-8

Key idea:

Everything has been pushed or pulled into motion and only stops when other forces act on them.

Specific Learning Objectives

Unit 1: Motion All Around

Exploration 1: Motion in Your World

- Objects exhibit a wide range of motions.

Exploration 2: What Makes Things Stop and Go?

- A force (a push or a pull) is required for an object to start moving.
- A force can act on an object even though the source of the force is not touching the object.

Unit 2: The Super Sliding Disk

Exploration 3: Let's Get Moving

- Scientists often construct special equipment to help them investigate and understand the natural world.
- A force (a push or a pull) is required to start an object moving.
- Once an object starts moving, it stays in motion without an external force pushing or pulling it.
- Friction forces can oppose the motion of moving objects and slow them down.

Exploration 4: Launching the Super Sliding Disk

- Special equipment is often necessary to investigate nature's behavior.
- A force (a push or a pull) must be applied to an object for it to start moving.

Exploration 5: Testing the Limits of Your Launcher

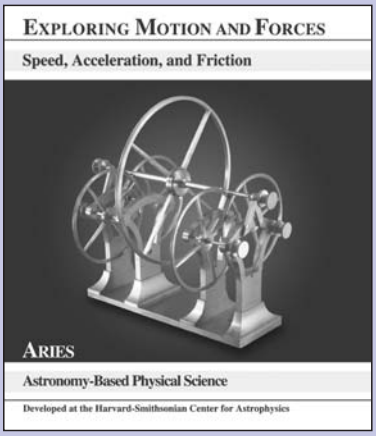
- The magnitude of a force (a push or a pull) acting on an object affects the distance the object moves.
- A stronger push results in an object moving a greater distance. A weaker push results in the object moving a shorter distance.
- A graph can be used to describe the relationship between the force acting on an object and the distance it moves.
- It is possible to determine if factors other than the launch force, such as the surface over which an object travels, affect how far the object moves by keeping the launch force constant while changing the other factors, one at a time.

Exploration 6: There's a Lot of Friction in This World

- An object moving along a horizontal surface slows down and stops.
- Only the action of an external force on an object can change its motion.
- One source of external force acting on a moving object comes from the object's contact with the surface on which it is moving. This force is called a friction force.
- Friction acts in a direction opposite to that of the object's motion.
- The magnitude of the friction force depends on the two surfaces that are rubbing against one another and on the weight of the moving object.
- Different surfaces in general result in different friction between the object and the surface over which it moves.

Important content:

- Forces ("pushes and pulls") and motion
- Inertia and friction
- Newton's model of gravity
- Speed and acceleration
- Motion on horizontal surfaces and inclined planes
- Falling, sliding, rolling, and wheeled motion



- All other aspects of an experiment being the same, a moving object travels a greater distance over a smooth surface than over a rough one.

Exploration 7: Floating on Air

- If a layer of air is introduced between a moving object and the surface over which it travels, the layer of air reduces friction and the object moves farther than it does without the air.
- In an environment with low friction, an object can move very far at a (nearly) steady speed.

Unit 3: Rolling Motion on an Inclined Plane

Exploration 8: Setting Up the Track

- Scientists often construct special equipment to help them investigate the natural world.
- A ball placed on an inclined track rolls down the track unless stopped by an obstacle.
- A push or pull is required to start the ball moving. The force ("pull") that starts the ball rolling down the inclined track and that continues to act on the ball is called gravity.
- The height at which the ball starts on the incline affects the speed at which it rolls along any chosen section of a horizontal track at the bottom of the incline.
- The height at which the ball starts on the incline affects how far it rolls on the horizontal track at the bottom of the incline.
- The horizontal motion of the rolling ball is affected by the friction force, which slows and then stops the ball.
- The horizontal motion of the rolling ball is not directly affected by the force of gravity, which acts only in the vertical (downward) direction.

Exploration 9: How Far Does It Roll?

- The higher up along an inclined track a ball starts, the farther it will roll along a horizontal track at the bottom of the incline.
- A bar graph can be used to describe the relationship between the push or pull acting on an object and the distance it moves.
- The results of experiments are a basis for developing general rules that describe nature's behavior.

Exploration 10: How Fast Does It Roll?

- The higher up along an inclined track a ball starts, the greater its average speed as it rolls along any section of a horizontal track at the bottom of the incline.
- The results of experiments are a basis for developing general rules that describe nature's behavior.

Exploration 11: Rolling Speed Along a Horizontal Track

- Evidence for an object speeding up or slowing down can be obtained by measuring and comparing the time the object takes to move two or more equal, consecutive distances.
- When a ball is rolling along a horizontal plane, it slows and then stops.

Exploration 12: Rolling Speed on an Inclined Track

- An object that speeds up as it moves (that is, goes faster and faster) is said to be accelerating.
- Evidence that a ball speeds up as it rolls down an incline can be obtained by measuring and comparing the time the ball takes to roll two or more equal, consecutive distances.
- A ball rolling down an inclined track accelerates.
- A ball rolling down a smooth, inclined track increases its speed at a constant rate while it is rolling down the incline. The ball is said to be in constant acceleration.
- An inclined track is used to study the speed of falling bodies because objects move more slowly rolling down an incline than they would if they were just dropped, making accurate measurement of their average speed easier.

Unit 4: Acceleration and the ARIES Speedcart

Exploration 13: Building the Speedcart

- A push or pull is required for an object to start moving.
- An object remains at rest unless an external force is applied.
- A rolling cart can be used to investigate the effects of pushes and pulls on motion.
- A rolling cart can represent many important properties of larger, four-wheeled vehicles, such as automobiles. Knowing about the properties of cart motion is useful for learning about the motion of other vehicles.

Exploration 14: Powering the Speedcart

- A force affects motion only in the direction in which the force is applied.
- An object in motion remains in motion unless an external force is applied to change the motion.
- If a push or pull continues to act on an object, the object continues to accelerate (that is, its speed increases with time).
- The magnitude of a push or pull that continues to act on an object affects the time it takes for the object to move a specific distance.

Exploration 15: Increasing the Falling Mass

- The magnitude of a push or a pull (force) that continues to act on an object affects the time it takes for the object to move a specific distance. The greater the magnitude of a push or pull, the faster the object will move.
- One way to quantify the motion resulting from a push or a pull that continues to act on an object is to measure the time it takes the object to move a specified distance.
- A graph can be used to describe the relationship between the magnitude of a push or pull acting on an object for a specific time and the time that it takes the object to move a specified distance.

Exploration 16: Adding Mass to the Cart

- The more massive an object is, the longer it will take to move a given distance when acted upon by a push or pull of a specific magnitude for a specific time.
- The magnitude of a push or pull that continues to act on an object affects the time it takes for the object to move a specific distance.
- One way to quantify the motion of an object resulting from a push or a pull that acts on it for a specific time is to measure the time it takes the object to move a specified distance.
- A graph can be used to describe the relationship between the magnitude of a push or pull acting on an object for a specific time and the time that it takes the object to move a specified distance.

Exploration 17: A Fan-Powered Speedcart

- A push or pull is required for an object to start moving.
- If a push or pull continues to act on an object, the object continues to accelerate (that is, its speed increases with time).

Exploration 18: How Fast Can the Fan Cart Move?

- Evidence for an object speeding up, slowing down, or moving at a constant speed can be obtained by measuring the time it takes the object to travel over each of two or more equal, consecutive distances.
- If a push or pull continues to act on an object, the object continues to accelerate (that is, its speed increases with time).