5-Minute Refresher: FRICTION

SIEMENS | Foundation

Discovery EDUCATION

SIEMENS STEM DAY | Science Technology Engineering Math

Friction- Key Ideas

- Friction is a force that occurs when two surfaces slide past one another.
- The force of friction opposes the motion of an object, causing moving objects to lose energy and slow down.
- When objects move through a fluid, such as air or water, the fluid exerts a frictional force on the moving object. The frictional force from a fluid is called a *drag force*.
- Friction examples: tires skidding to a stop on a road, sandpaper rubbing against wood, air pushing against the nose of an airplane

SIEMENS STEM DAY | Science Technology Engineering Math

Friction- Drag Force

- Friction drag force causes objects to slow down as they move through a fluid, such as air or water.
- Drag force depends primarily on the following variables:
  - Cross-sectional area of object moving through the fluid
  - Speed of moving object
  - Density of the fluid
  - Drag coefficient (determined by experiments; related to the shape of the object)
- Drag force is especially dependent on the speed of an object. As an object's speed increases, the drag force from the fluid increases exponentially.
- For example, when you drive at high speeds, the frictional force of air on the car increases, and fuel economy decreases.

SIEMENS STEM DAY | Science Technology Engineering Math

Friction- Air Resistance

- Air is a fluid through which people and objects regularly move.
- As objects move through air, they experience a drag force known as air resistance.
- In the absence of air resistance, all objects falling through the air would fall at the same rate (e.g. bowling balls and feathers dropped from the same point would fall to the ground at the same speed).
- One way to reduce air resistance is to decrease the cross-sectional area of a moving object. This is known as making the object more “aero-dynamic.”

SIEMENS STEM DAY | Science Technology Engineering Math

Friction- Learning Objectives for Grades K-3

- Objects have physical properties.
- The physical properties of objects can affect how an object moves.
- Aside from the physical properties of objects, different things in the world around us can change the motion of an object.
- Example: a push can make something go faster; air can make things move faster or slow things down
- Note: the word “force” is not typically introduced in these grade levels

SIEMENS STEM DAY | Science Technology Engineering Math

Friction- Learning Objectives for Grades 4 - 6

- Forces are a push or pull on an object.
- Friction is a force that opposes the motion of objects; friction can cause objects to slow down.
- Air resistance is a type of friction.
- Air resistance causes moving objects to slow down.
- Different physical properties, such as the shape of an object, affect the air resistance on an object.

SIEMENS STEM DAY | Science Technology Engineering Math

Friction- Prior Knowledge for Grades K - 3

- Students should understand the meaning of the word motion, and they should be able to identify objects that are in motion and at rest.

- Students have most likely observed the following:
  - Some things move quickly and other things move slowly. Specifically, some things fall to the ground quickly and other things fall more slowly.
  - When you kick a ball or slide a book across the floor, it eventually comes to rest.

SIEMENS STEM DAY | Science Technology Engineering Math

Friction- Prior Knowledge for Grades 4 - 6

- Students should understand that forces affect the motion of objects, causing them to slow down, speed up, or change direction.
- Most students have observed the force of air resistance before:
  - When students ride a bike or run, they feel the force of air pushing back on them.
  - When students observe objects falling through the air, they witness the effects of air resistance pushing back on the objects. Examples: falling leaves, paper, parachutes

SIEMENS STEM DAY | Science Technology Engineering Math

Friction- Common Misconceptions

- People should always try to reduce friction in a system.
  - **Reality:** Sometimes friction is helpful. For example, friction between car tires and the road prevents the car from sliding out of control, and friction between your shoes and the ground prevents you from slipping.
- Pencils fall to the ground faster than a feather because pencils are heavier.
  - **Reality:** The rate at which objects fall to the ground on Earth depends on air resistance. Shortly after a feather is dropped, the weight of the feather acting downwards is balanced by the air resistance acting upwards on it, so the feather stops accelerating and falls very slowly. The air resistance on the pencil does not balance the weight of the pencil as quickly, so the pencil continues to accelerate towards the ground and reaches a higher maximum speed than the feather. Thus, the pencil arrives at the ground first. Without air resistance, all objects would fall to the ground at an equal rate, regardless of their mass.

SIEMENS STEM DAY Science Technology Engineering Math

Friction- Additional Information

Parachutes use the principle of air resistance to slow skydivers falling through the air. To see this in action, watch the video at the following link:

http://siemensscienceday.com/activities/what_a_drag.cfm

SIEMENS Foundation Discovery EDUCATION