

# Recognizing Forces in Realistic Situations

*Adapted from Minds on Physics: Inquiry Activity #45*

## **Goal:**

- ✓ This activity will familiarize you with several common forces.
- ✓ After completing this activity you should be able to:
  - Discuss the behavior of the forces of gravitation, spring, tension, normal, friction, and air resistance.
  - Decide whether a particular force is present in a given situation.

## **Knowledge Needed:**

- ✓ When two objects interact, each exerts a force on the other.
- ✓ A force is any push or pull.
- ✓ Physics deals with many forces, but we will only use five of them for this activity.

## **Common Forces:**

<i>Force (Symbol)</i>	<i>Short Description</i>	<i>When is this force present?</i>
Normal ( $F_N$ )	The force that one object exerts on another by pushing on it. The direction is directly away from the surface that exerts the force and perpendicular to the surface.	Whenever two objects are touching.
Tension ( $F_T$ )	The force that a string, cable, cord, or rope exerts on an object pulling on it. The direction is always parallel to the string and away from the object being pulled.	Whenever a string is attached and taut (rather than slack.)
Gravitational ( $F_g$ )	The attractive forces that objects exert on each other due to their masses.	Whenever two objects both have non-zero mass.
Drag ( $F_d$ ) (air resistance, water resistance)	The force that air (or another fluid) exerts to oppose the motion of an object moving relative to it. The direction is opposite the relative motion of the object and the air.	Whenever an object moves through the air, or when there is wind.
Static Friction ( $F_{fs}$ )	The force that one object exerts on another to prevent it from sliding across it. The direction is parallel to the two surfaces in contact.	Whenever there is non-zero normal force and when the objects would slide without the force.
Kinetic Friction ( $F_{fk}$ )	The force that objects exert on each other when they are sliding across each other. The direction is opposite the relative motion of the two objects.	Whenever there is a non-zero normal force and a non-zero coefficient of kinetic friction.

Note that there are only three forces that do not require contact. They are the exception to the rule:

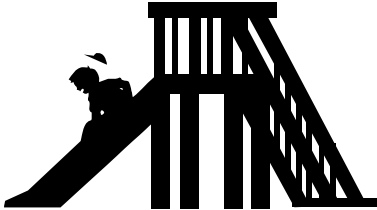
- ✓ Gravitational
- ✓ Electric
- ✓ Magnetic

**Instructions:**

- ✓ For each of the following situations, indicate the following:
  - Which forces are exerted on the given object.
  - What features of the situation you used to determine the presence of each force.
  - What agent (object) exerts each force.
  - The general direction of each force.

**Example:**

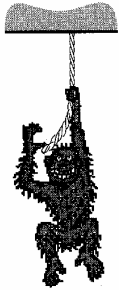
Consider a child sliding down a slide. Examine the forces acting on the child.



Force	Feature	Agent	Direction
Gravitation	The child has mass.	Earth	Straight downward, toward the center of the Earth.
Normal	The child is in contact with the slide.	The Slide	Up and to the left, perpendicular to the slide's surface.
Kinetic Friction	The child is moving relative to the surface of the slide.	The Slide	Up and to the right, parallel to the slide's surface.

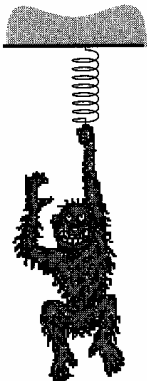
Note: The child and the slide also exert gravitational forces on each other because they both have mass. However, we are only interested in the gravitational force that the Earth (or other planetary objects) exerts.

1. A monkey hangs at rest from the ceiling by a rope. Consider only the forces on the monkey.



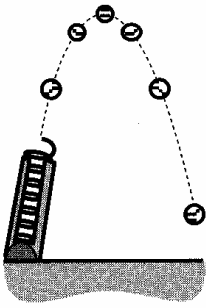
Force	Feature	Agent	Direction

2. A monkey hangs at rest from the ceiling by a spring. Consider only the forces on the monkey.



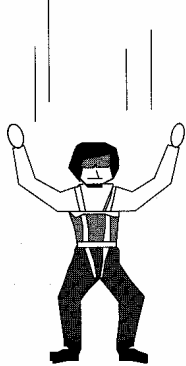
Force	Feature	Agent	Direction

3. A ball is shot into the air with a spring-loaded cannon. Consider the forces on the ball only at its highest point.



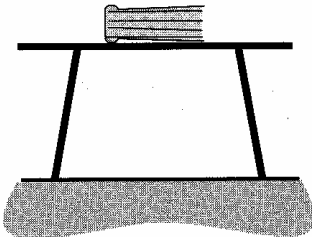
Force	Feature	Agent	Direction

4. A skydiver (who has not yet opened her parachute) falls at constant velocity (terminal velocity.) Consider only the forces on the skydiver.



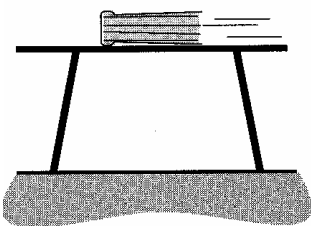
Force	Feature	Agent	Direction

5. A book sits at rest on top of a table. Consider only the forces on the book.



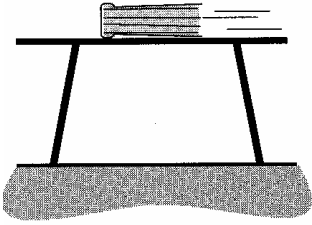
Force	Feature	Agent	Direction

6. A book slides across the top of a table. Consider only the forces on the book.



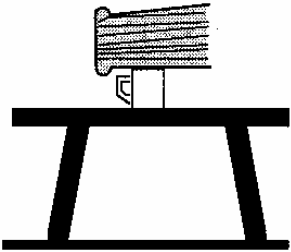
Force	Feature	Agent	Direction

7. A book slides across the top of a table. Consider only the forces on the table.



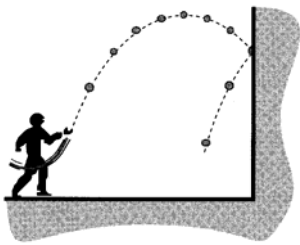
Force	Feature	Agent	Direction

8. A coffee mug is at rest on the top of a table. Consider only the forces on the coffee mug.



Force	Feature	Agent	Direction

9. A ball is bouncing off the wall. Consider only the forces on the ball *during the bounce*.



Force	Feature	Agent	Direction