Activating Strategy

Forces

Essential Question:

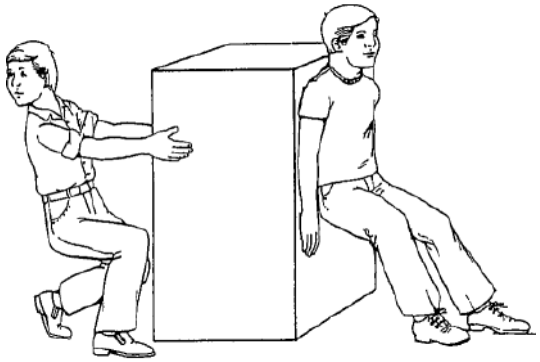
How do gravity, inertia, and friction affect the balance of forces?

Standard:
S8P3b. Demonstrate the effect of balanced and unbalanced forces on an object in terms of gravity, inertia, and friction

What is a force?

A force is a push or pull

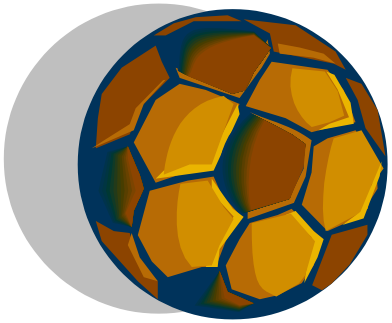
Forces



- Forces have size and direction and are expressed in Newtons (N)
- Force is always exerted by one object on another object
- Balanced forces produce no change in motion
- Unbalanced forces produce a change in motion

Forces

If you roll or kick a ball, what happens eventually?



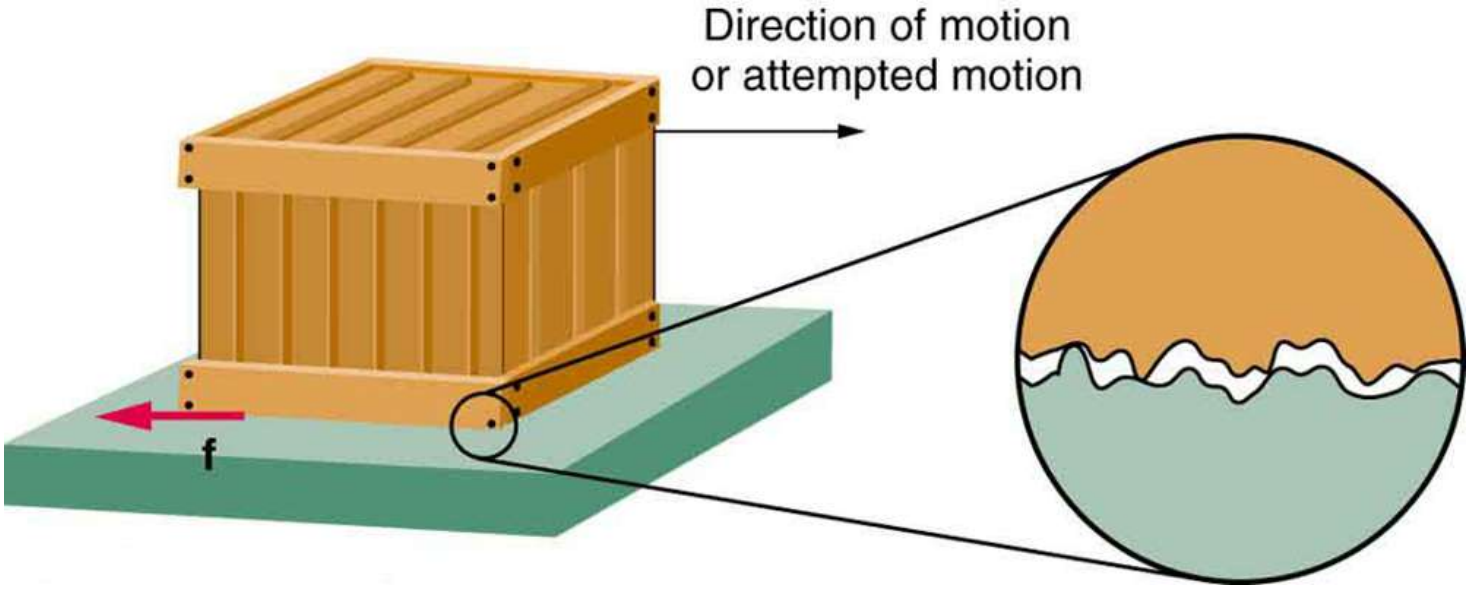
An unbalanced force is needed to change the speed of a moving object. So, what force is stopping the ball?

Forces: Friction

Friction is a force that opposes motion between two surfaces.

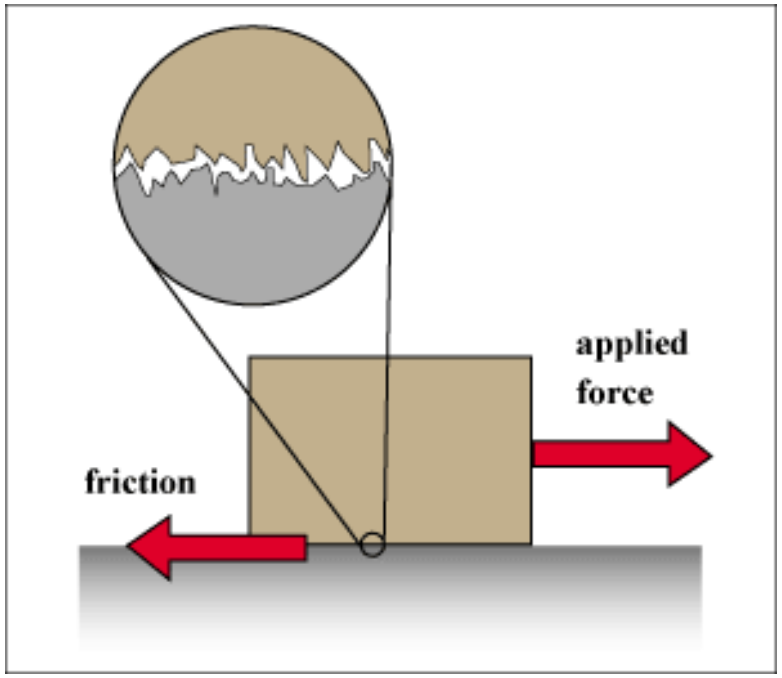
Forces: Friction

Friction occurs because the surface of any object is rough. Even surfaces that feel smooth are covered with microscopic hills and valleys.



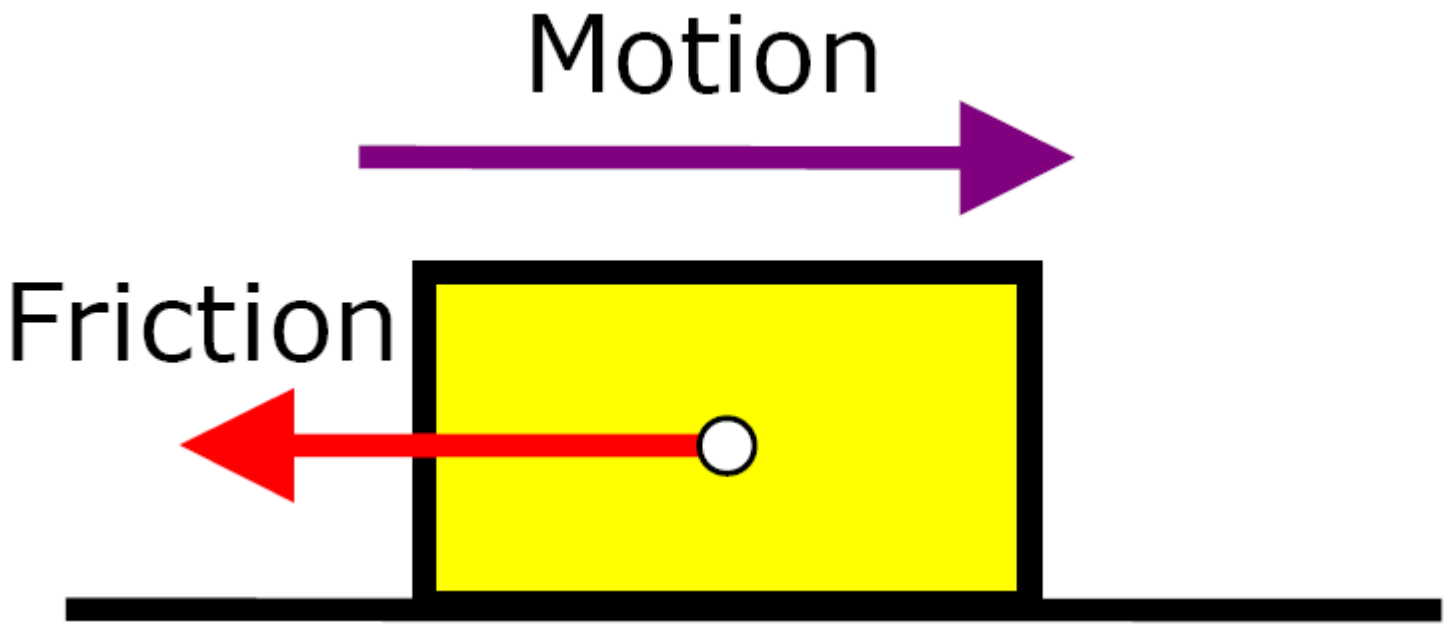
Forces: Friction

When two surfaces are in contact, the hills and valleys of one surface stick to the hills and valleys of the other surface.



Forces: Friction

The amount of friction depends on factors such as roughness of the surfaces and the force pushing the surfaces together.



Forces: Friction

Turn to a partner and identify surfaces that may cause more friction.

ICE

Less Friction?

Friction: Friend or Foe?

Friction: Friend or Foe?

Even though we don't usually think about it, we feel and use the force of friction every day in many ways. Sometimes friction can be our friend and other times it is our worst enemy. As an introduction to friction, I am going to describe 4 situations that involve friction. You tell me if friction is acting like a friend or foe?

1. You are sliding into second base and scratch up your leg. Friend or Foe?

2. You are trying to turn your bike around a sharp curve. Friend or Foe?

3. You are trying to race down a water slide at Six Flags. Friend or Foe?

4. You are trying to push your desk into another room. Friend or Foe?

5. You are driving in a car and see a possum walking in front of you. Friend or Foe?

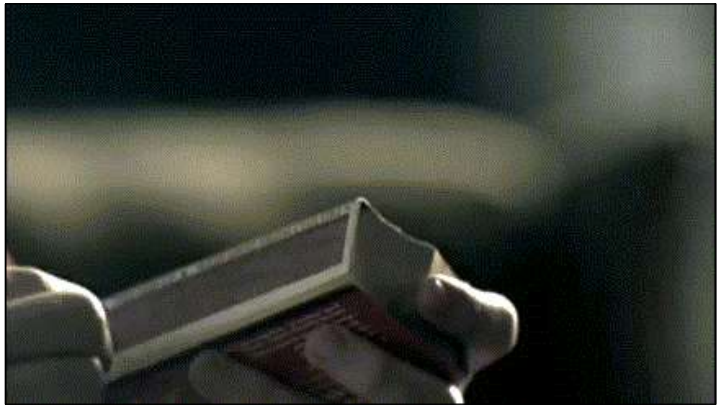
Forces: Friction

Friction is both harmful and helpful. Turn to an elbow partner and identify some examples of friction being harmful and friction being helpful.

Forces: Friction

Falling

Lighting a match

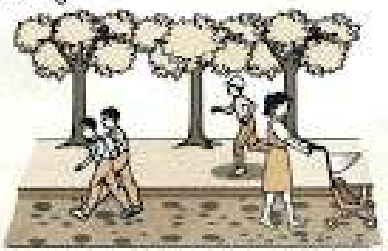


Breaks and tires on a car

Rubbing your chest, arms, and legs to get warm

Forces: Friction

(a) **Prevents us from slipping** when walking or running



Friction between the sole of a shoe and the surface of the ground prevents us from slipping.

(b) **Stops a moving vehicle**

A moving vehicle will stop when the brake is pressed because there is friction between the tyres and the road surface.

(c) **Keeps the position** of an object on a surface

Our furniture does not move because there is friction between the base and the floor surface.

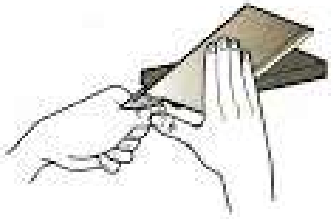
(d) **Produces fire**

Friction between a match and the box can produce fire.

(e) **Holds or grips things**

Friction helps us to hold a glass or grip a pencil and write.

(f) **Sharpens a knife**



Friction causes an object to wear out. This enables us to sharpen a knife or pencil.

Forces: Friction

Is it beneficial to reduce or increase friction? Why or Why Not?

Forces: Friction

Which of the following would NOT help you move a heavy object across a concrete floor?

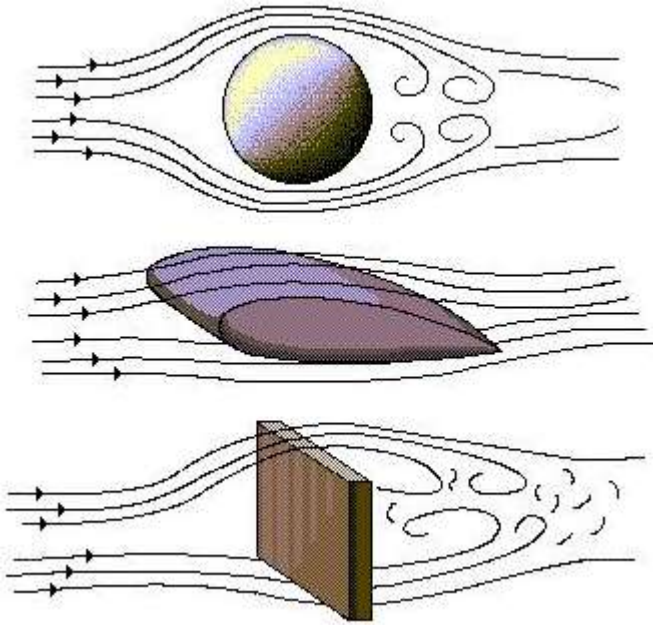
Water, ball bearings, oil, liquid soap, steel rods, foam rubber

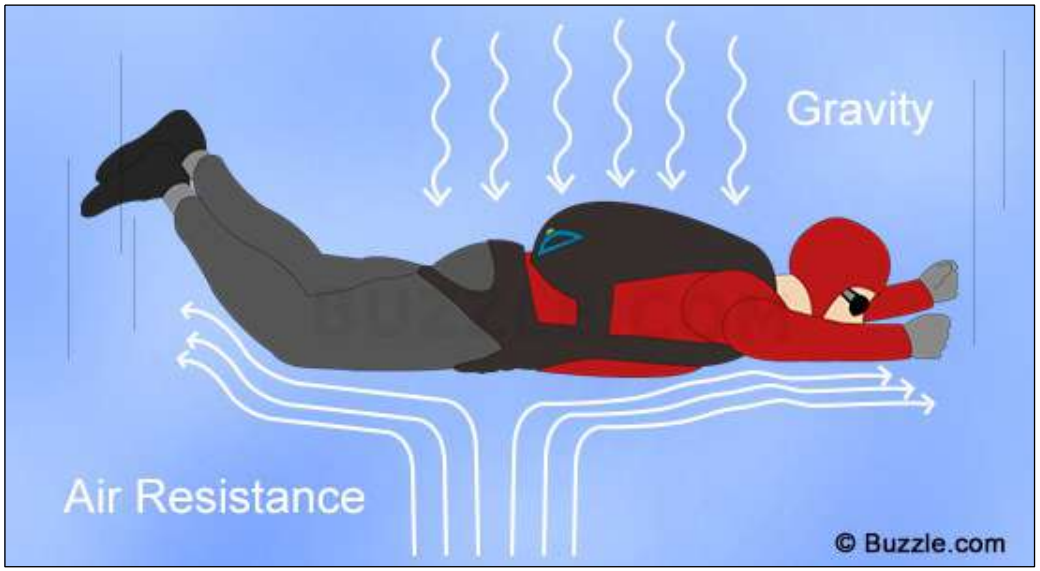
Name three common items you might use to increase friction.

Forces: Air Resistance

Air resistance is a form of friction.

Look at the images below. Why would air resistance be a form of friction?

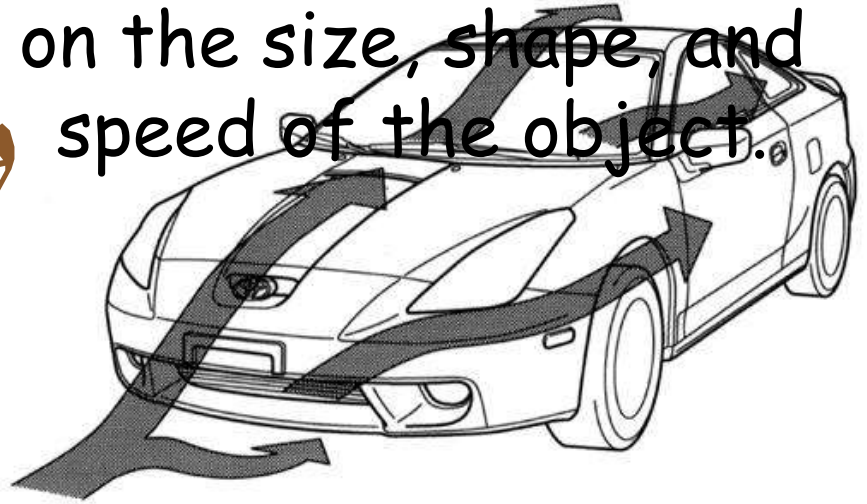




Forces: Air Resistance

Would a school bus or a racing car be affected less by air resistance? Why?

Air resistance depends on the size, shape, and speed of the object.



Falling Water Demonstration

http://www.csiro.au/helix/sciencemail/activities/DropCup.html

http://www.thenakedscientists.com/HTML/content/kitchenscience/exp/weightless-water/

What force is acting on the cup and the water?

Gravity

- Gravity is a force of attraction between objects that is due to their masses.
- All objects experience an attraction toward all other objects. This gravitational force pulls objects toward each other.

Gravity

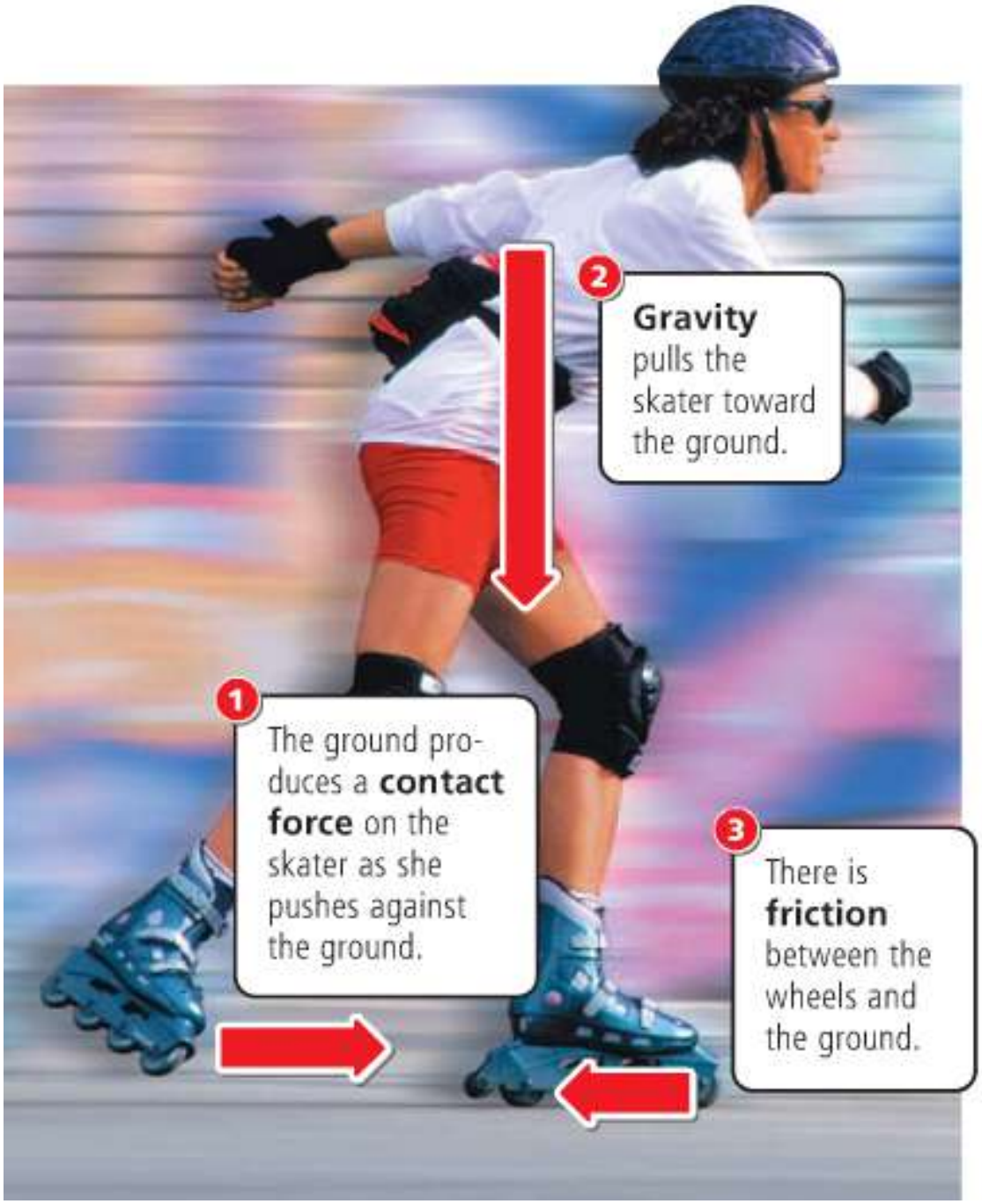
- Compared with all other objects around you, Earth has a huge mass. Therefore, Earth's gravitational force is very large.
- You must apply forces to overcome Earth's gravitational force any time you lift objects or even parts of your body.

Gravity

- Earth's gravitational force pulls everything toward the center of Earth.
- Because of this force, the books, tables, and chairs in the room stay in place, and dropped objects fall to Earth rather than moving together toward you.

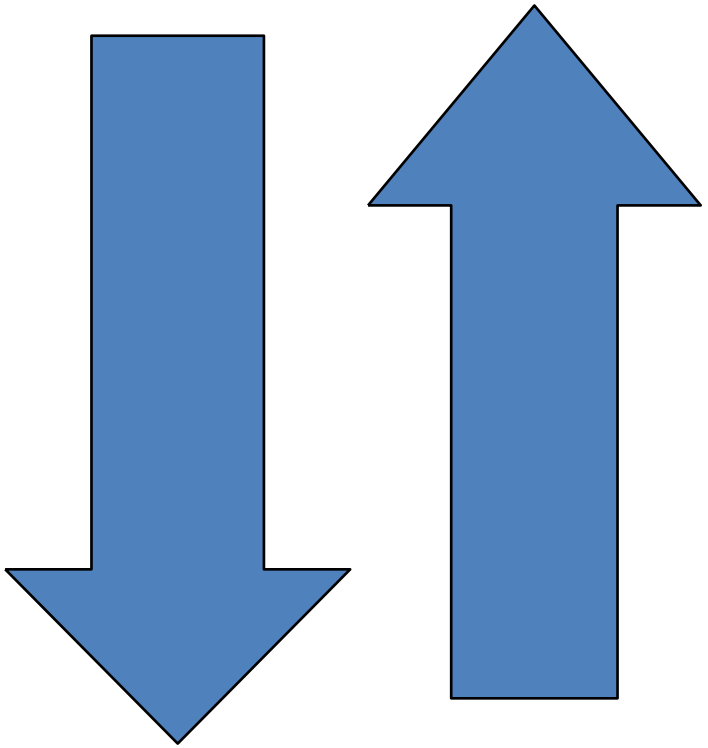
Forces Review

- There are many different forces which act on objects such as gravity and friction.
- If forces are balanced the object doesn't move
- If forces are unbalanced the object will do one of the following things:
  - Begin to move
  - Stop moving
  - Change direction
  - Speed up
  - Slow down


2
Gravity pulls the skater toward the ground.
1
The ground produces a contact force on the skater as she pushes against the ground.
3
There is friction between the wheels and the ground.

Forces occur in pairs and they can be either balanced or unbalanced

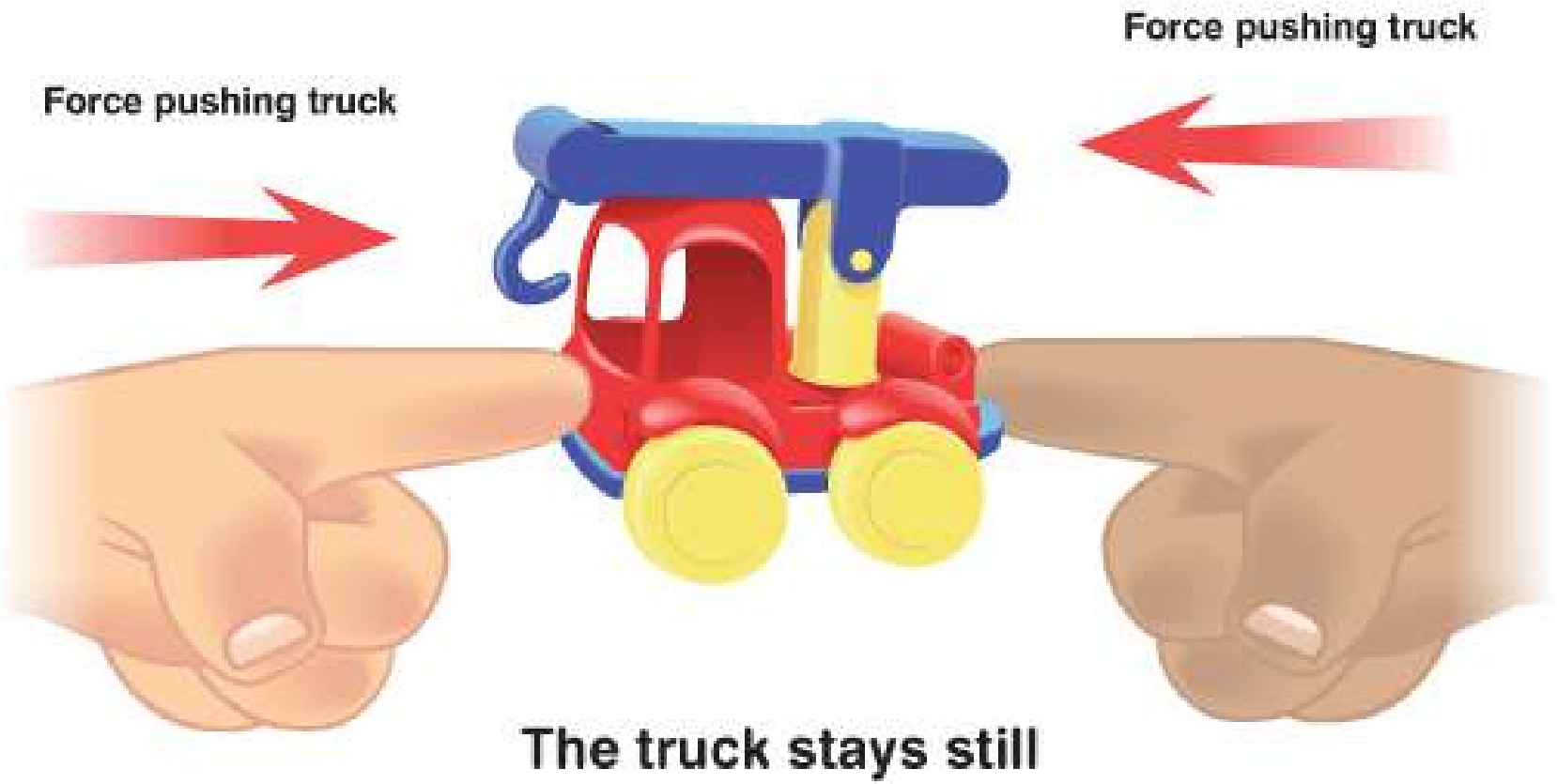
Balanced Forces



When two forces acting on an object are equal in size, but are opposite in direction, we say the forces are balanced.

Balanced forces do not cause a change in motion.

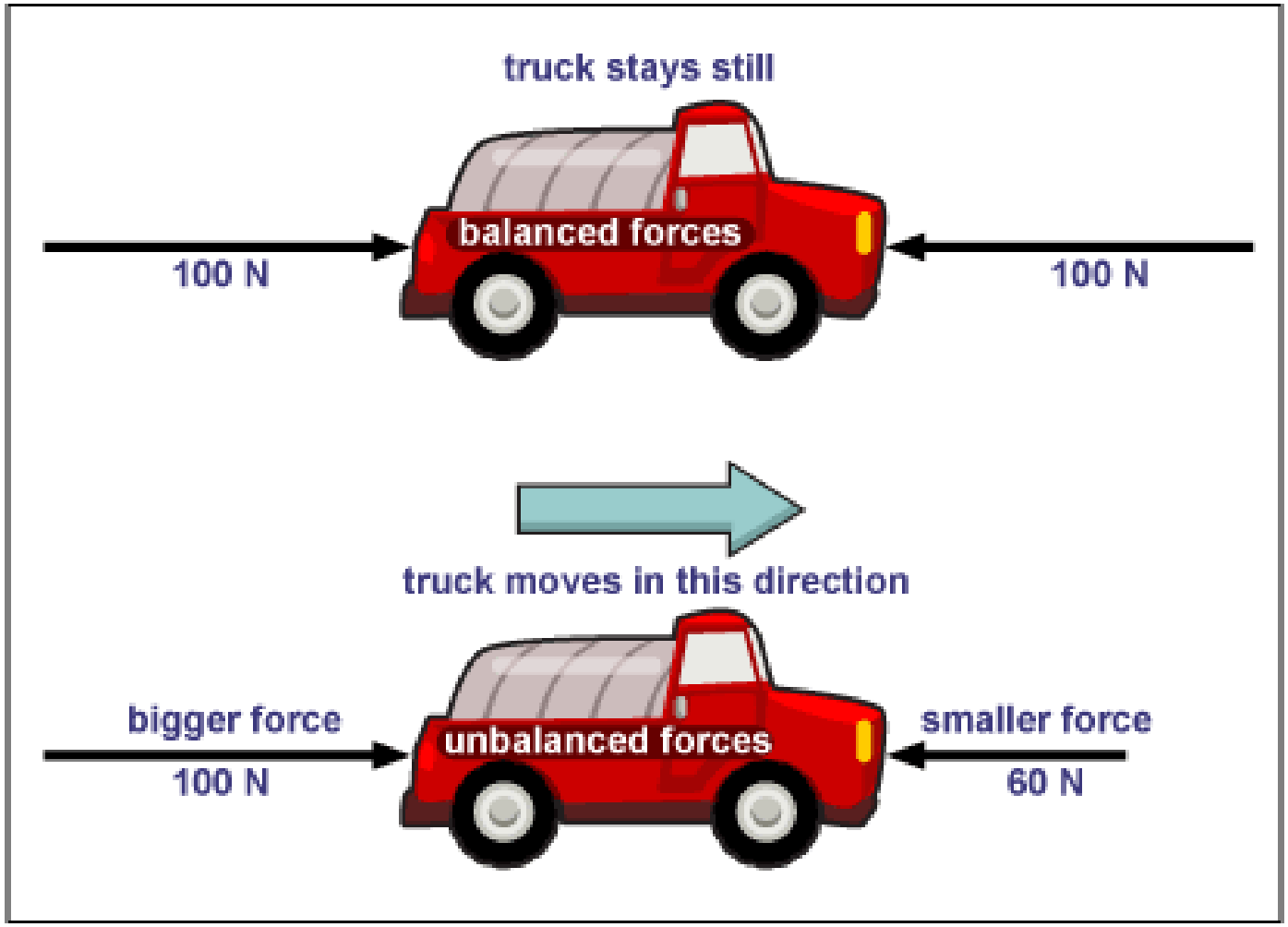
Balanced Forces



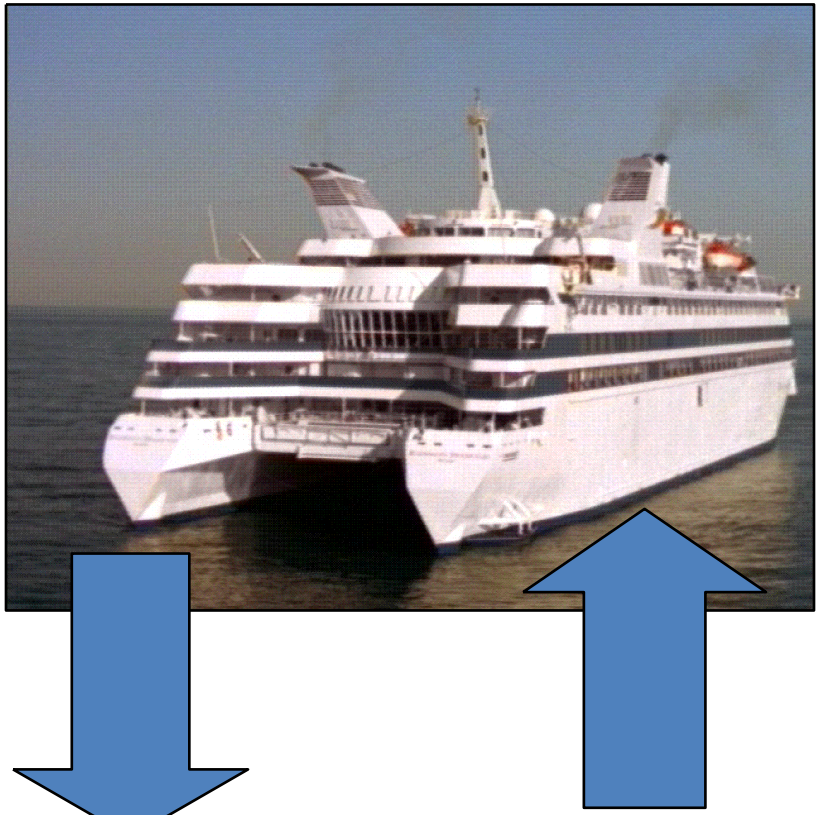
Force Diagrams

- We can show the forces acting on an object in a force diagram.
- In a force diagram, the force is shown with an arrow – the larger the arrow, the bigger the force
- The arrows in a force diagram also show the direction that the force is acting on
- Sometimes, the arrow will be labeled with the size of the force in Newtons (N). A larger number means a larger force.

Force Diagrams



Balanced Forces



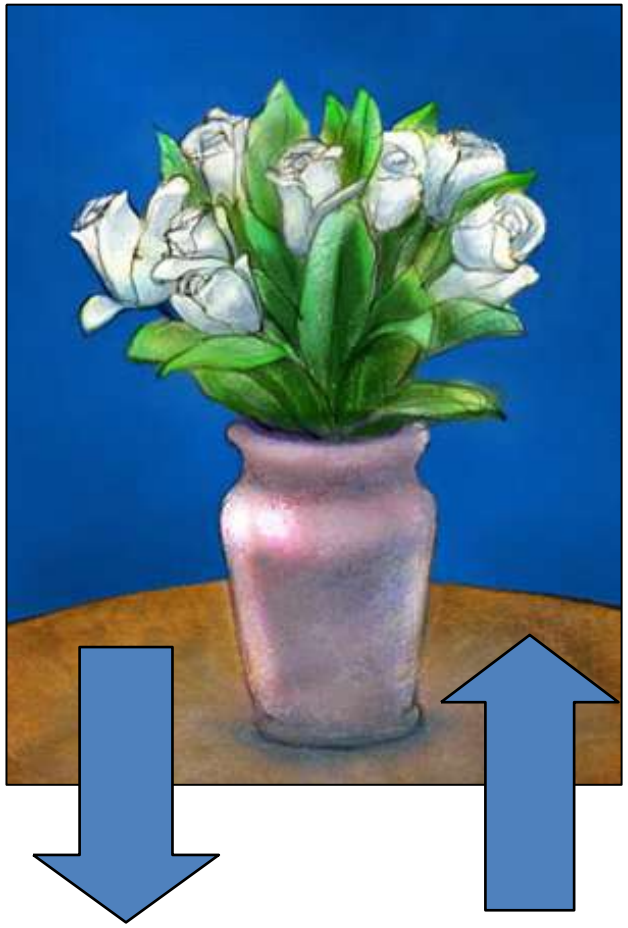
Gravit
y

Water's
upward force

The ship is floating on the water, the forces are balanced. Which forces are acting on the ship?

Because Gravity's force down and the water's force up are equal the ship stays afloat.

Balanced Forces

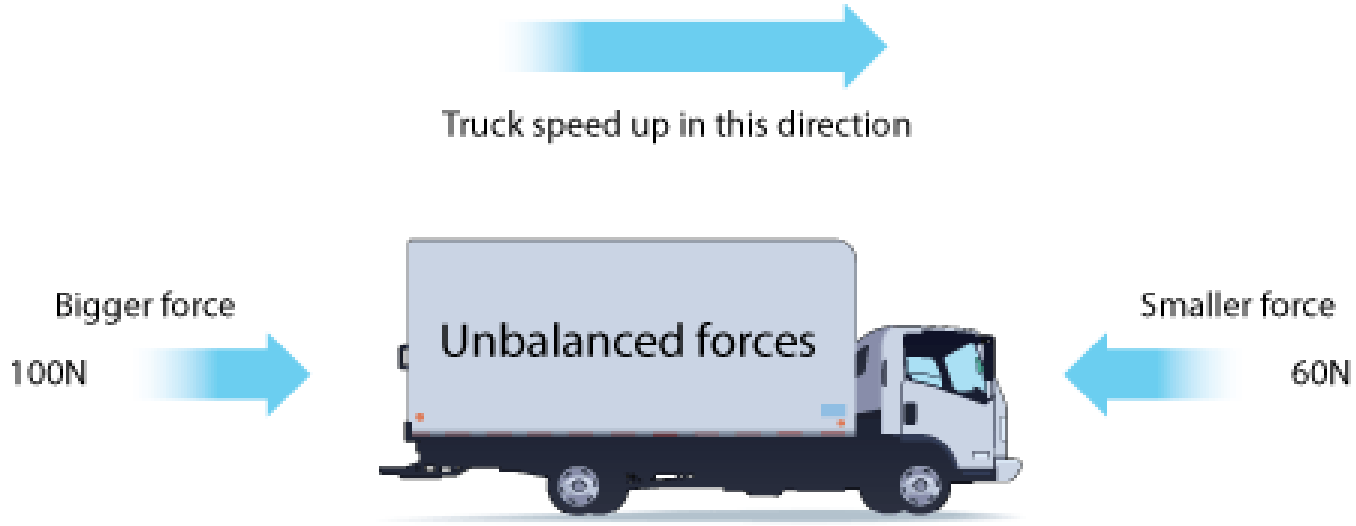


The vase is resting on the table. It is not moving, therefore the forces must be balanced.

Which forces are acting on the vase?

Have a look around the classroom and name some of the balanced forces in action on different objects.

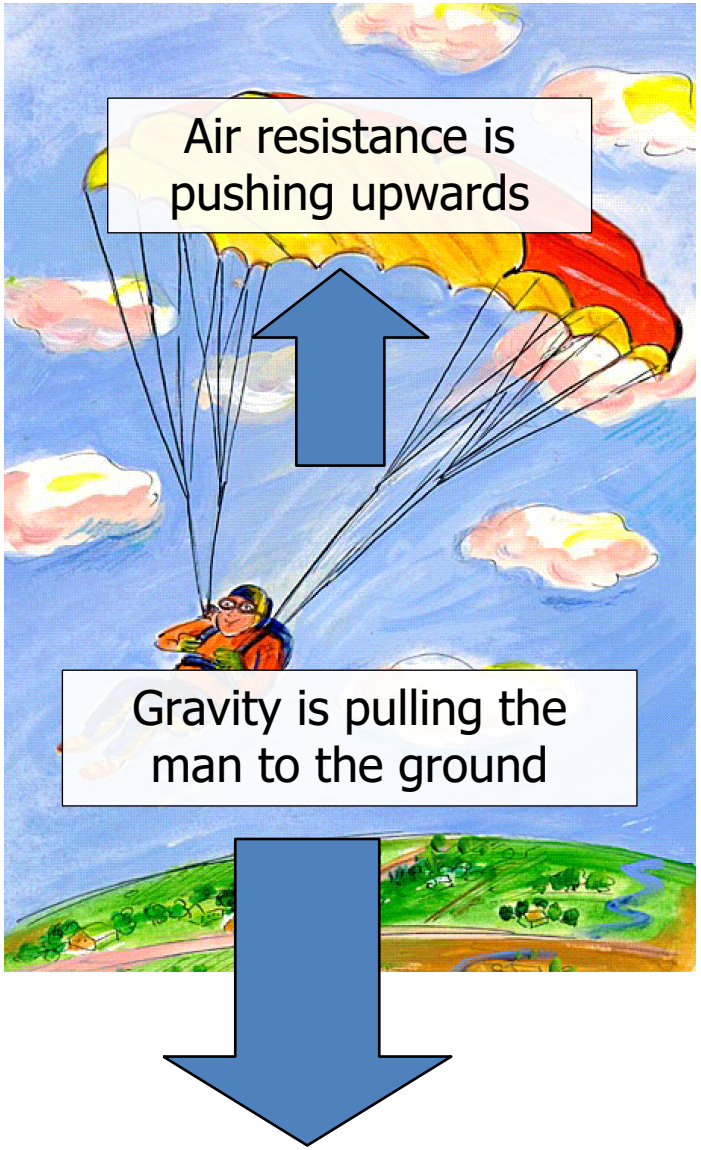
Unbalanced Forces



When two forces are acting on an object and are not equal in size, we say the forces are unbalanced.

Unbalanced forces cause a change in motion by changing the object's speed or direction.

Unbalanced Forces



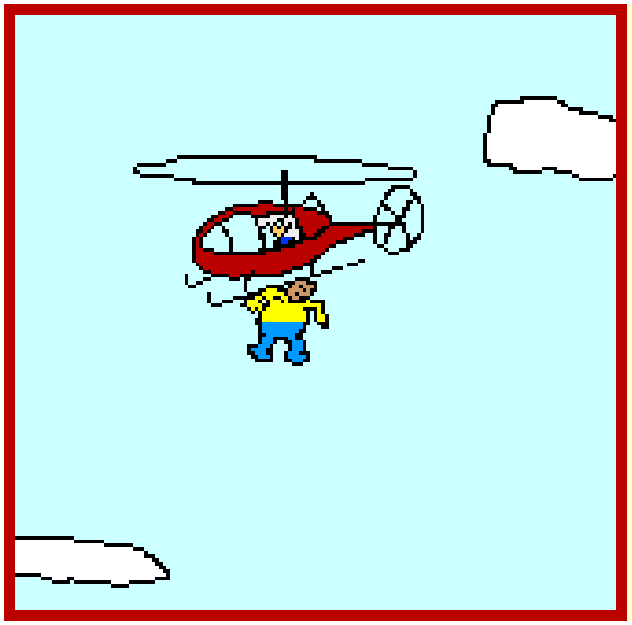
The man and the parachute are slowly falling to the ground.

Which forces are acting on the parachute?

Which force is bigger? How can you tell?

Gravity is the bigger force. We can tell this because the direction of movement of the man and the parachute is the same as the direction of the force of gravity.

Unbalanced Forces



$$a = \frac{F_{net}}{m}$$

$$a = \frac{1000\ N}{100\ kg}$$

$$a = 10.0\ m/s^2$$

(down)

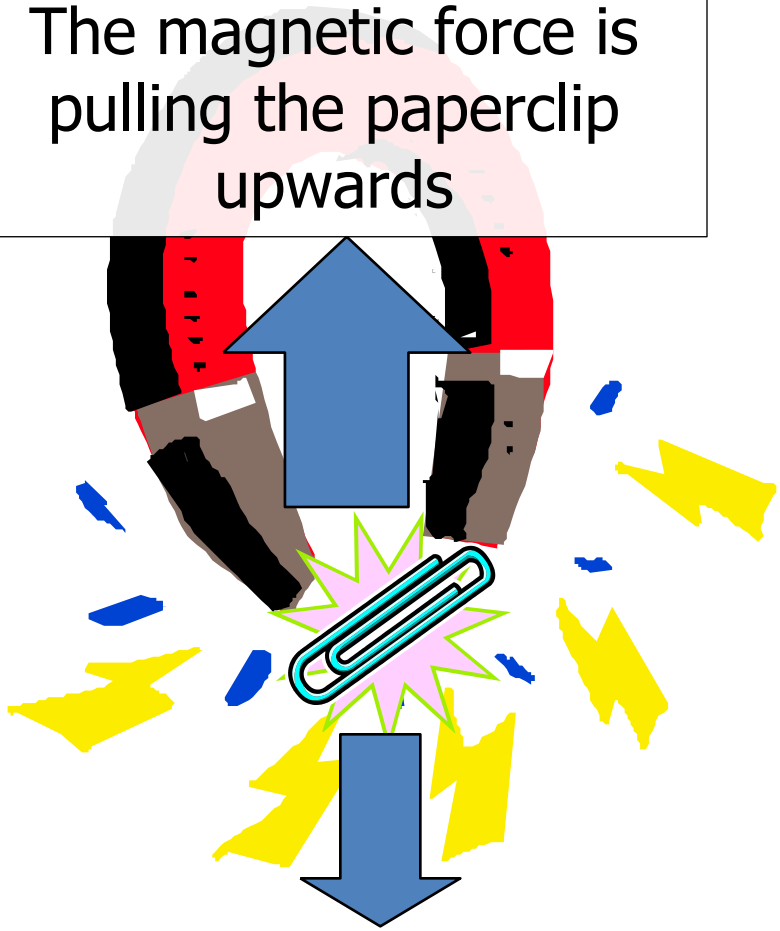
Unbalanced Forces

The same forces are acting on the elephant, but without a parachute there is much less air resistance.

Gravity is a much bigger force. Because there is a bigger difference between the force pulling downwards and the force pushing upwards, the elephant falls much more quickly than a man with a parachute.

Unbalanced Forces

The magnetic force is pulling the paperclip upwards



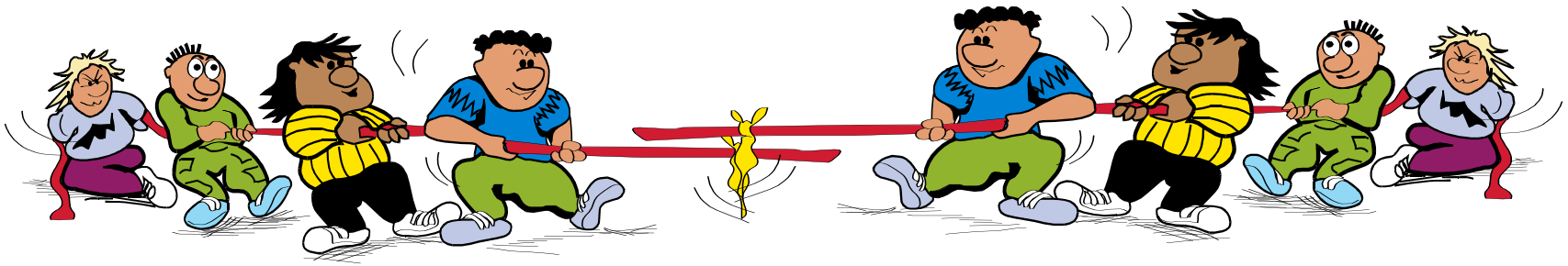
Gravity is pulling the paperclip to the ground

The paperclip is jumping up to the magnet.

Which forces are acting on the magnet? Which is the greater force?

The magnetic force is greater than the force of gravity therefore the paperclip moves in the direction of the biggest force.

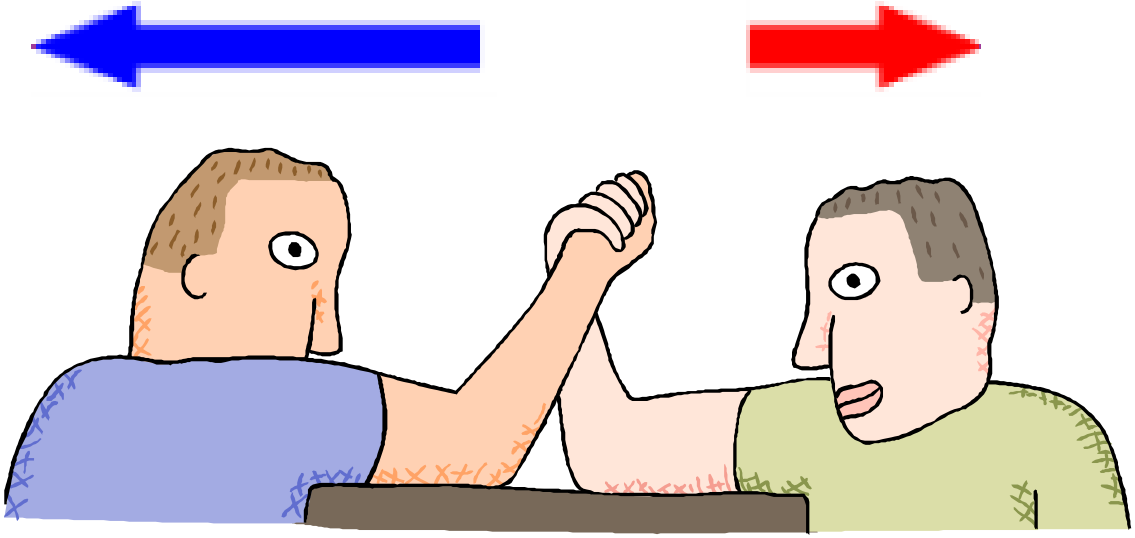
Forces



Each team is exerting a force – what happens if the pulling force produced by each team is equal?

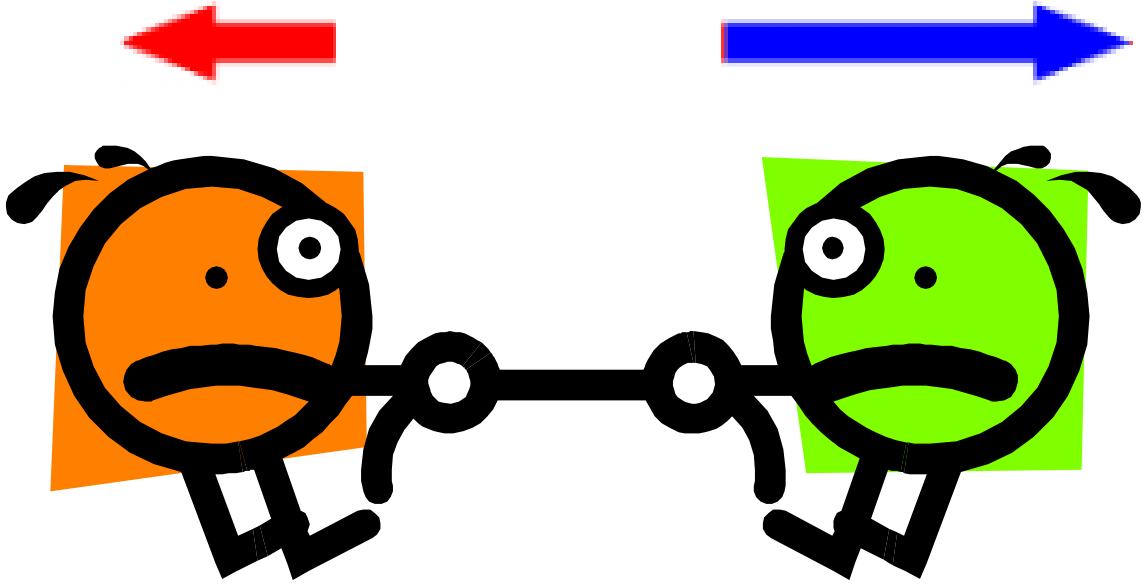
What would happen if the team on the left were able to produce a bigger pulling force than the team on the right?

Unbalanced Forces



Based on the forces shown:
Which arm wrestler will likely win?
Which direction will both arms move?

Unbalanced Forces



4 N, left

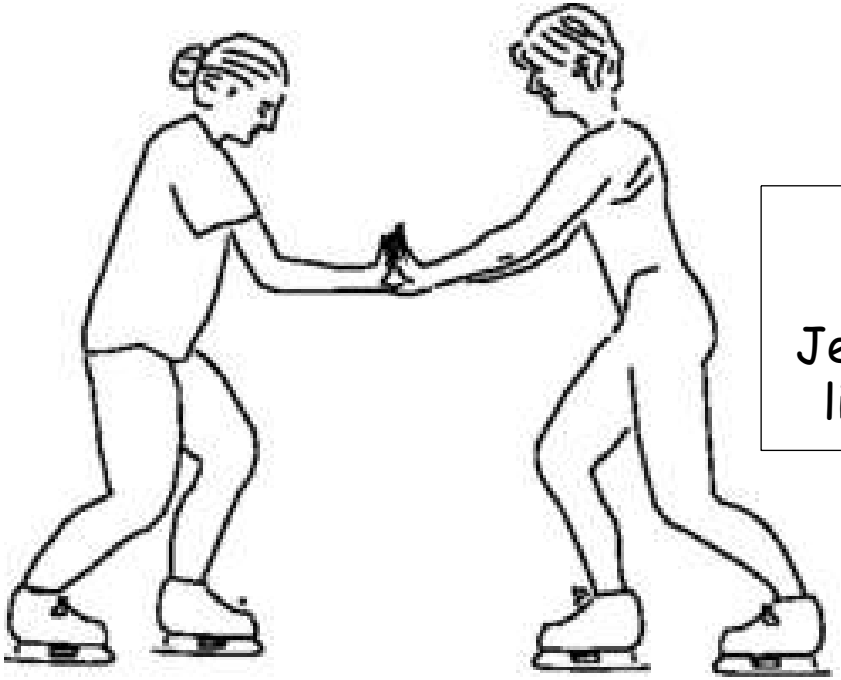
10 N, right

Which direction will the rope move?

Unbalanced Forces

Which direction will the ball roll?

Look at the diagram below. Both women are wearing ice skates on an ice rink. If both women push off from one another, which woman will most likely move the furthest? Why?



Julie will move the furthest because Jennifer's push will most likely have more force

Jennifer weighs 175 pounds

Julie weighs 130 pounds

Imagine that you are playing baseball. The pitch comes in and you hit the ball hard.

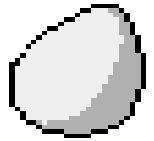
But, instead of flying off the bat, the ball just drops to the ground. Is that normal?

You would probably say no. You know that force and motion are related.

When you exert a force on a baseball by hitting it with a bat, the baseball should move.

Isaac Newton explained this relationship between force and the motion of an object.

Diving Egg Demonstration



https://www.youtube.com/watch?v=STQRUzaIH2M

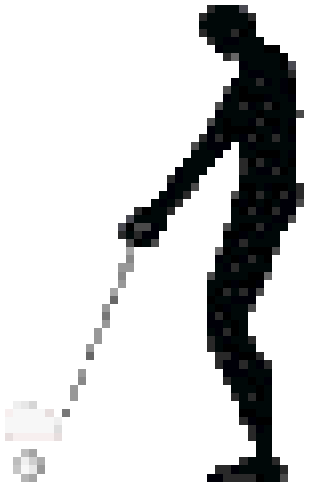
What happened to the egg?
Why?

What happens when riding bumper cars? Why?

Law of Inertia

Inertia is the tendency of an object to resist being moved or, if the object is moving, to resist a change in speed or direction until an outside force acts on the object.

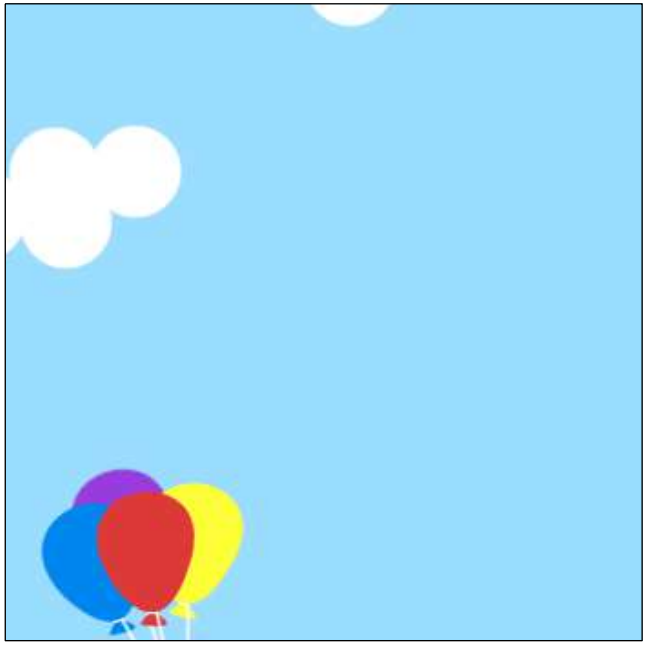
Law of Inertia



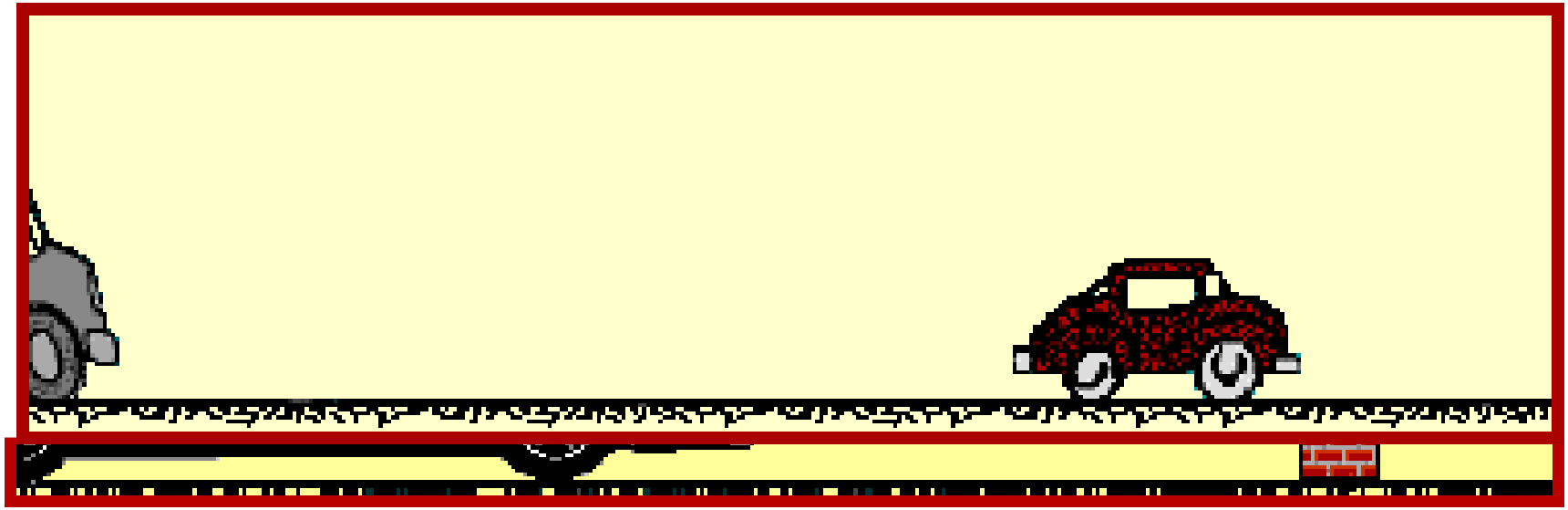
- Because of Inertia, an object at rest will stay at rest unless acted on by an unbalanced force.
- In other words, objects will not start moving until a push or a pull is exerted on them.

Law of Inertia

Law of Inertia



- An object in motion remains in motion unless acted on by an unbalanced force.
- The object will continue to move in the same direction with the same speed unless an unbalanced force occurs.

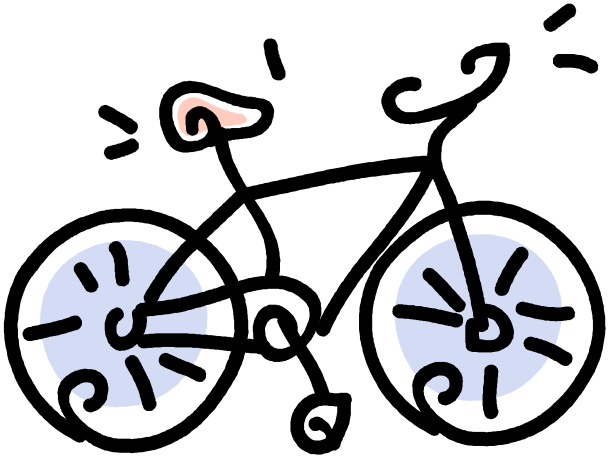


Mass and Inertia

- Mass is a measure of Inertia
- An object that has a small mass has less inertia than an object that has a large mass
- So, changing the motion of an object that has a small mass is easier than changing the motion of an object that has a large mass.

Mass and Inertia

Look at the images below. Which would require more force to move or slow down? Why?



The car because it has more mass therefore more inertia.

Mass and Inertia

Which would require more force to move or slow down? Why?

The bowling ball because it has more mass therefore more inertia.

The snowboard is in motion. Based on the Law of Inertia, the snowboard will keep moving right?

What force(s) allow him to snowboard on the brick wall and rail?

Friction and the Law of Inertia

Objects in motion remain in motion unless acted on by an unbalanced force. Friction is often the unbalanced force that causes objects to slow down and stop moving.

Because of friction, the motion of objects changes.

Newton's First Law of Motion: Inertia

Formative Assessment Check

If a moose were chasing you through the woods, its enormous mass would be very threatening. But if you zigzagged, then its great mass would be to your advantage. Explain why.

Activities on Forces

[see resources]