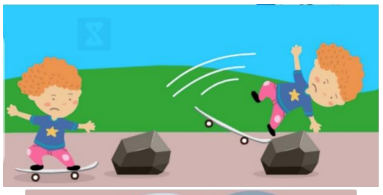
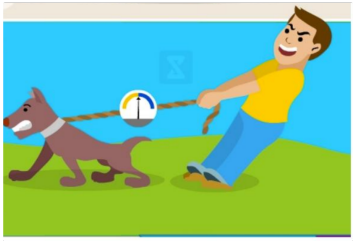
Balloon Rockets and Newton's Laws



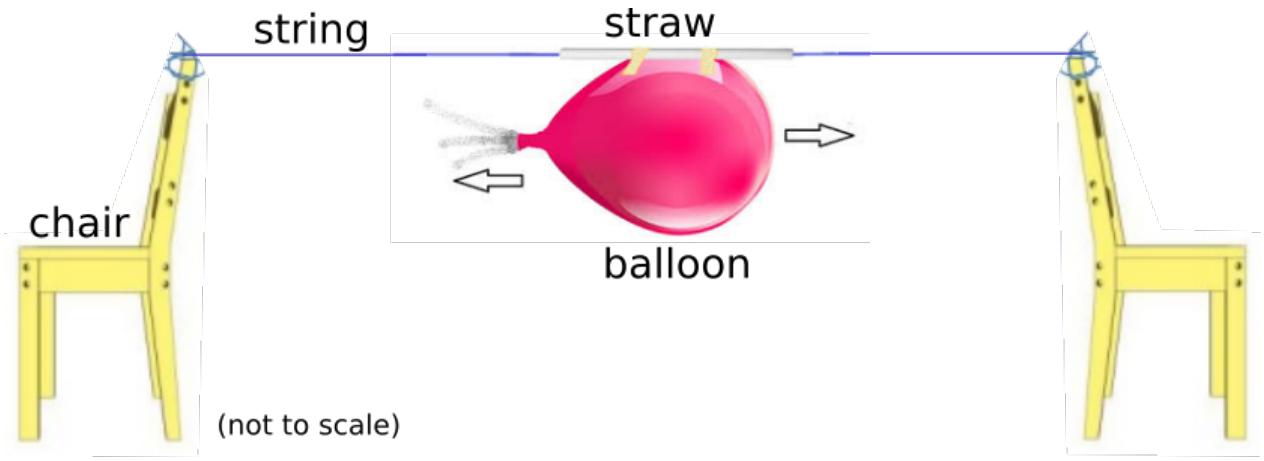


- A **force** is a push or pull by some object on another object.
- **Newton's 1st Law:** all objects have **inertia** – this means they will keep moving with the same speed in the same direction unless a force pushes or pulls them.
- **Newton's 2nd Law:** The more mass an object has, the more force is required to change its motion.
- **Newton's 3rd Law:** If object 1 pushes on object 2, then 2 must push on 1 with an equal but opposite force.

Part 1: Newton's 3rd Law

We will make a balloon rocket that flies using **jet propulsion**.

1. Set two chairs at opposite ends of the room, with their backs to each other. They should be at least 10 feet apart.
2. Cut a drinking straw in half. Keep only the straight half.
3. Tie a string to the back of one chair. Put the straw on the string. Tie the other end to the back of the other chair. Move the chairs so the string is stretched tight.
4. Take a pea-sized piece of modeling clay and insert it into the balloon (this will make it spin less).
4. Blow up the balloon so that it is about 7" across. Twist up the end but do not tie it. Use a clip to secure the end temporarily.
5. Use a piece of tape to attach the balloon to the straw (underneath).
6. If possible, have one partner film the balloon's flight so you can watch it again later.
7. Remove the clip. Then let go of the balloon and see what happens!



The balloon exerted a force (pushed) on _____ in the _____ direction

According to Newton's 3rd law:

The _____ exerted an equal and opposite force on the balloon, pushing it in the _____ direction.

Making an object move by throwing some material in the other direction is called **jet propulsion**. This is how rockets are able to propel themselves through empty space!

Part 2: Newton's 2rd Law

Let's see what happens if we increase the mass (inertia) of the balloon.

1. Make a ball of modeling clay about 1" across.
2. Break up that ball into small pieces. Roll into balls or snakes and insert into the neck of the balloon, a little at a time.
3. Blow up the balloon again so that it is 7" across. Twist the end and secure with a clip.
4. Make a prediction:

Do you think the balloon will fly: faster slower about the same ?

5. Tape the balloon beneath the straw again. Again, have one partner film the flight.
6. Remove the paperclip and release! If you need to, compare the videos to watch how the balloon's speed changed.

Did you observe the balloon flying: faster slower about the same ?

Do you think the force the balloon exerted on the air was:
smaller larger about the same?

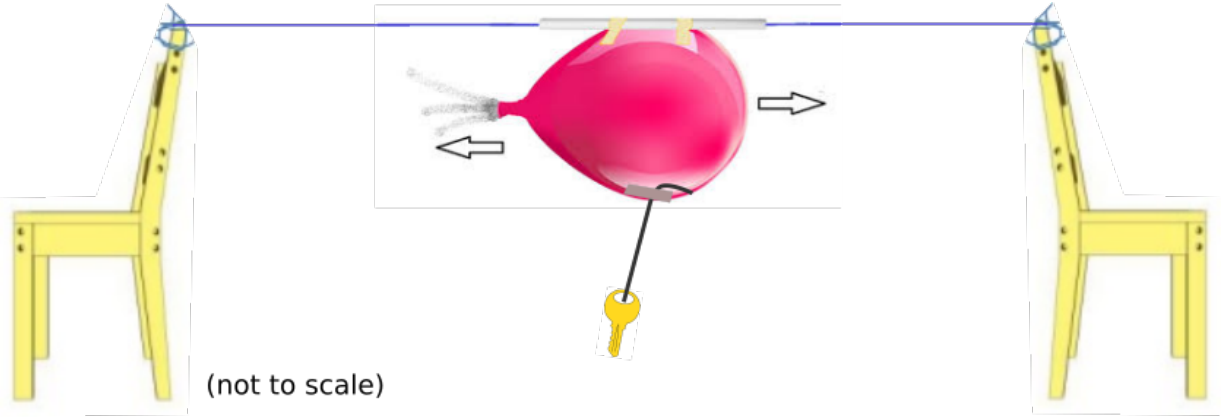
What about the force the air exerted on the balloon?

Why did the balloon change its speed?

Part 3: Newton's 1st Law

Now we will see what happens to an object when the rocket it's riding on suddenly starts or stops.

1. Cut a 12" piece of string and tie one end to a key.
2. Leaving the modeling clay inside the balloon, blow it up again until it is 7" across. Twist the end and secure with a clip.
3. Tape the other end of the string with the key to the side of the balloon to make a pendulum.
4. Tape the balloon underneath the straw so that the pendulum is hanging beneath it.



5. Make a prediction:

When the balloon first starts moving, the key will swing:

in front of the balloon behind the balloon

When the balloon slows down to a stop, the key will swing:

in front of the balloon behind the balloon

6. Remove the paperclip, untwist the end, and let go of the balloon. This time, record a video in slow motion.

Were your predictions right?

Newton's 1st law says that a moving object will keep moving in the same direction with the same speed until some force causes it to stop or change.

Why is it important to wear a seat belt while in the car? What will happen to you if you have no seat belt and the car suddenly stops?