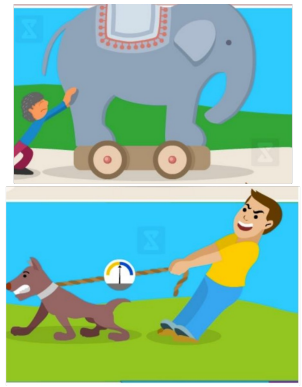
Balloon Rockets and Newton's Laws

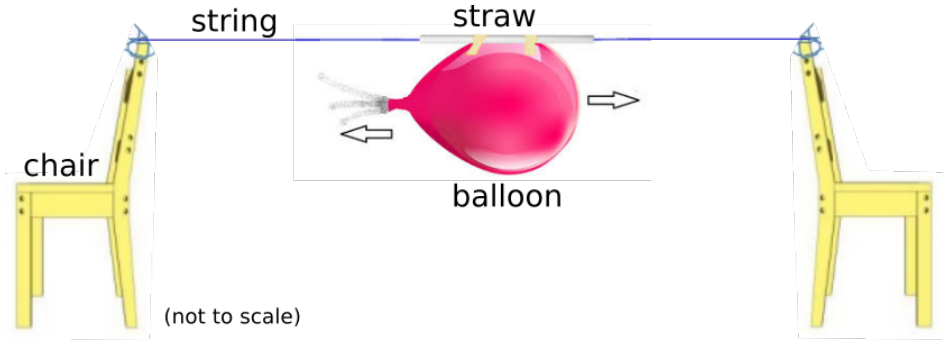


- A **force** is a push or pull by some object on another object.
- **Newton's 2nd Law:** The more mass an object has, the more **inertia** it has and the more force is required to change its motion.
- **Newton's 3rd Law:** If one object pushes another, then the 2nd object must push back on the first with,equal but opposite force.

Part 1: Action-Reaction

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

1. Cut a straw in half to make it shorter
2. Find two locations (eg: table legs), about 10 steps apart, to be the ends of your track.
3. Tie a string to one location. Thread the string through the straw. Tie down the other end to make a taut, straight track.
4. Insert a pea-sized piece of modeling clay into a balloon (this will make it spin less).
5. Blow up the balloon so that it is about 5" across. Twist up the end but do not tie it. Use a clothespin to secure the end temporarily.
6. Use a piece of tape to attach the balloon underneath the straw.
7. Remove the clothespin. Then let go of the balloon and see what happens!



The balloon exerted a force 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.

Discuss:
What force made the balloon start moving? What force made it stop moving eventually? What could you change to make it go faster?

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

Part 2: Mass and Acceleration

The **inertia** of an object depends on its **mass** (how much material it has).
Let's try increasing the inertia of your balloon.

1. Make a ball of modeling clay about 1" across.

2. Break up the ball into small pieces or snakes and insert into the neck of the balloon.

3. Blow up the balloon so that it is ~5" across. Twist the end, secure with a clothespin.

4. Make a prediction:

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

5. Tape the balloon beneath the straw again. Remove the paperclip and release!

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

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

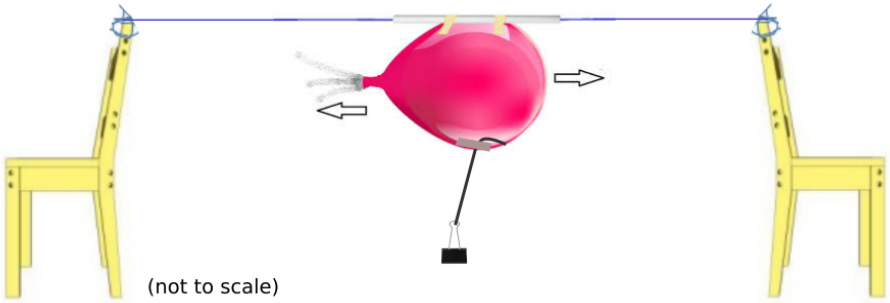
What about the force the air exerted on the balloon?
smaller larger about the same?

Explain why the balloon moved faster or slower when it had extra clay inside it.

If you have extra time:

The balloon rocket can be used to see **inertia** in action again.

1. Cut a 12" piece of string and tie one end to a binder clip
2. Leaving the modeling clay inside the balloon, blow it up again until it is 5" across. Twist the end and secure with a clip.
3. Tape the other end of the string with the binder clip 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 binder clip 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. If possible, have a grownup record a video of the flight on their phone, ideally in slow motion.

Were your predictions right?

Newton's 1st law (Law of Inertia) 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.