

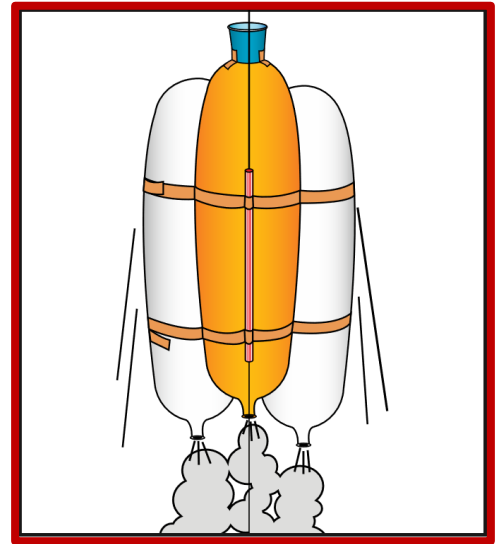
# Balloon Rocket Activity

## Introduction: (20 minutes)

Show the NASA video of the Heavy Lift Program:

<https://youtu.be/u2nod-ek7ys>

Ask the students what they know about the new rocket that NASA is building.



NASA's Space Launch System, or SLS, is an advanced launch vehicle for a new era of exploration beyond Earth's orbit into deep space. SLS will be the world's most powerful rocket and will launch astronauts in NASA's Orion spacecraft on missions to the Moon and eventually to Mars. The Orion spacecraft will carry up to four astronauts beyond low Earth orbit on long-duration, deep space missions and include both crew, service modules, equipment, and experiments. The SLS will offer the greatest-ever payload mass and volume and energy to speed missions through space.

The first test flight of the SLS, Exploration Mission-1 (EM-1), is scheduled for the summer of 2020. The first test flight will use the Block 1 SLS configuration, which stands 322 feet, taller than the Statue of Liberty, and weighs 5.75 million lbs. SLS will produce 8.8 million lbs. of maximum thrust, 15 percent more thrust than the Saturn V rocket. Block 2 will be even bigger and more powerful.

Lifting heavy payloads to orbit is challenging. Rockets require powerful engines and massive amounts of propellants.

*Explain why is it important to construct efficient heavy-lift vehicles?*

Traveling into space is a very difficult and expensive endeavor. Huge rockets and tremendous amounts of propellants are required to accomplish the job. With some rockets, launch costs were approximately \$20,000 per kilogram of payload delivered into Earth orbit. If that cost were to continue, imagine staying at a space hotel where it would cost about \$10,000 for a half liter bottle of drinking water! Improving heavy-lift rockets, such as making them lighter and more fuel efficient, will enable us to accomplish much more in space at far more reasonable costs!

## Balloon Rocket Instructions:

### Materials:

- Large binder clips (one per launch pad)
- Fishing line or smooth string
- Long balloons (see note below about sources)
- Bathroom size (3 oz) paper cup
- 2 straight drinking straws
- 50 small paper clips
- Sandwich size plastic bag
- Masking tape
- Balloon hand pumps (optional)
- Wooden spring-type clothespins (optional)

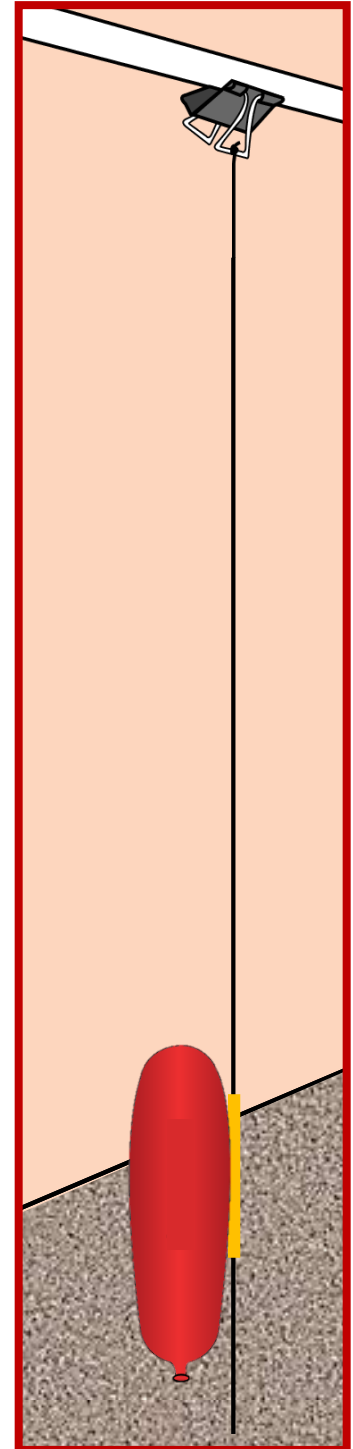
Balloon Sources: Many party supply stores carry variety packs that may include long balloons. Ask if they will special order packs of long balloons for you. The balloons become cylinders 5 inches in diameter and 24 inches long when inflated. They are sometimes called 524 (5 by 24 inches) airships. Find manufacturers and distributors by searching “524 balloons” on the Internet.



### Objective:

Students construct balloon-powered rockets to launch the greatest payload (paperclips) possible to the classroom ceiling.

Student teams receive identical parts with which they construct their rockets. Drinking straws guide balloon rockets up strings suspended from the ceiling. Teams compete to launch the greatest number of paper clips to space (ceiling).



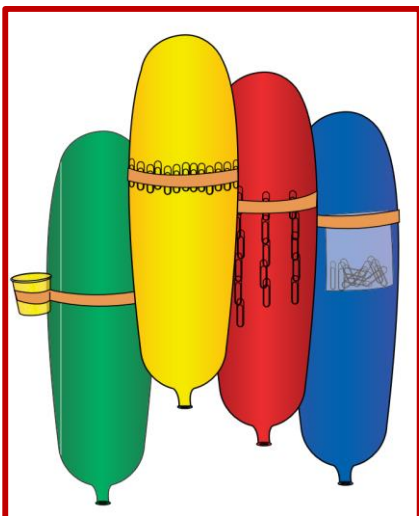
## Building & Testing of the Balloon Rockets: (45 minutes)

1. Divide your students into teams of three and explain the project to them:

NASA is looking for creative ideas for launching heavy payloads into orbit. Payloads include parts and supplies for the International Space Station and spacecraft that will carry humans to the Moon and Mars. NASA is also interested in rockets that can transport large fuel tanks that will be used to power deep space rockets. You are challenged to build the most efficient heavy-lift rocket from the same set of materials.

**The team that is able to lift the greatest payload (paper clips) into space (the ceiling) is the winner.**

2. Provide each team with an identical kit of materials. Tell them that any or all of these materials can be used for their rockets.
3. Tell the students that the first step is to brainstorm and discuss their rocket design and give their rocket a name.
4. Review the launching procedure. Explain how the straw guides the rocket up the fishing line or string and that the line must be held snug to the floor for the launch. Remind the teams that they only get four balloons. They can launch as many times as they want trying to improve how many paper clips they can successfully lift. The teams will be given a balloon coupon to get one extra balloon if one of their balloons has a malfunction.
5. Have the students conduct one prototype launch with only one balloon. This step is to give them an idea of how the launch process works before adding payload (paper clips) and multiple balloon designs.



Some different ways students may devise to carry the paper clips. The plastic bag can be used too. Let teams come up with their own ideas

## Building & Testing of the Balloon Rockets - continued:

6. A chart will be drawn on the board for teams to record their results (i.e., the number of paper clips that their rocket lifted to the ceiling).

Rocket Name	Number of Paperclips Lifted	Mass Lifted (1 paperclip = 2 grams)
Monster Rocket	13	26 grams
Avenger One	8	16 grams
Star Chaser	26	52 grams