

## Balloon Astronaut Design Challenge

**Introduction:** One of the many jobs of astronauts is that of mechanic, performing maintenance and fixing the manmade objects in space. In order to do this work, astronauts must exit the durable spacecraft and perform the dangerous work of extravehicular activity (EVA) activities that take place outside their spacecraft.

What hazards are faced by astronauts performing extravehicular activities (EVAs)? What systems need to be in place in order to protect astronauts?

There are more than 500,000 pieces of debris, or “space junk” in orbit of Earth, traveling at speeds of up to 17,500 mph. At these speeds, even small pieces of debris can cause damage to satellites, spacecraft, and their human occupants.

### Student Outcomes:

1. Students will be able to design and build a protective device to keep their balloon astronaut from popping when impaled by a falling nail.
2. Students will be able to explain design considerations based on material characteristics, and concepts of energy, velocity, and the physics of colliding objects.
3. 3. Students will be able to utilize the three step design process to meet an engineering challenge.

### The Challenge:

Design an outfit for your balloon astronaut that will protect it from the effects of being hit by small space debris moving at high speeds.

### The Constraints:

- Protective wear must fit snugly on the astronaut.
- No adhesives may be used.
- Maximum of four individual layers may be used. (you cannot double or triple wrap)
- Must be flexible.
- Must consist of at least three different materials.

**Testing:** Nails will be dropped down the PVC pipe pointed-side fist down the pipe. No body parts should be in the test area while the nail is falling. **A successful design is represented by an intact balloon.**

### Materials per team of 2-3 Engineers

- Rubber bands, • String, • Plastic grocery bags/trash bags, • Tissue paper, • Aluminum foil, • Paper towels, • Newspaper, • Wax paper, • Scissors, • Paper grocery bags

**Every team and every student was eventually awarded prizes as designs were modified, improved and tested at the discretion of the Judge and the peer involvement/critique of the other teams**







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