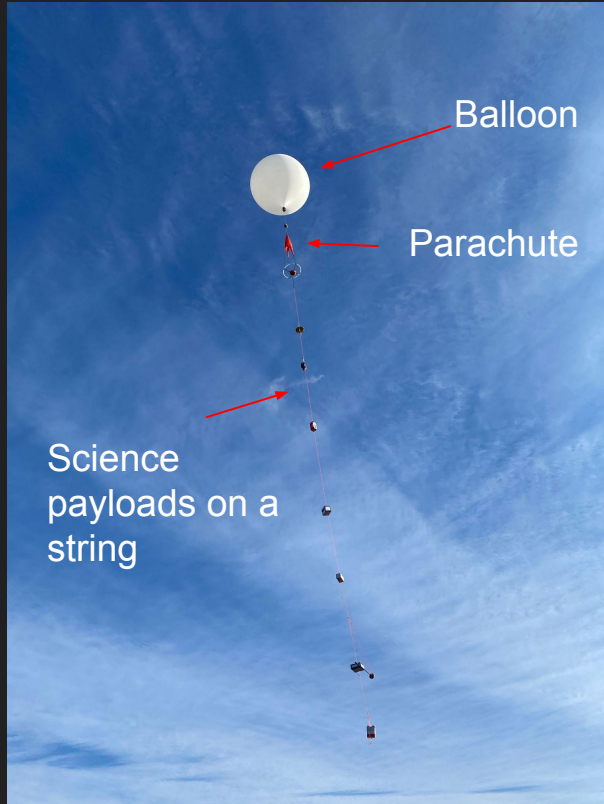


# Forces... and Balloons!

Lesson 5: Forces: lift, gravity, and air resistance

Brought to you by the University of Maryland Balloon  
Payload Program!

# What do we do?



Weather balloons help collect data to give you weather forecasts!

They carry science payloads to do research and take photos, like ours!

# How do we inflate them?

## Helium tanks!

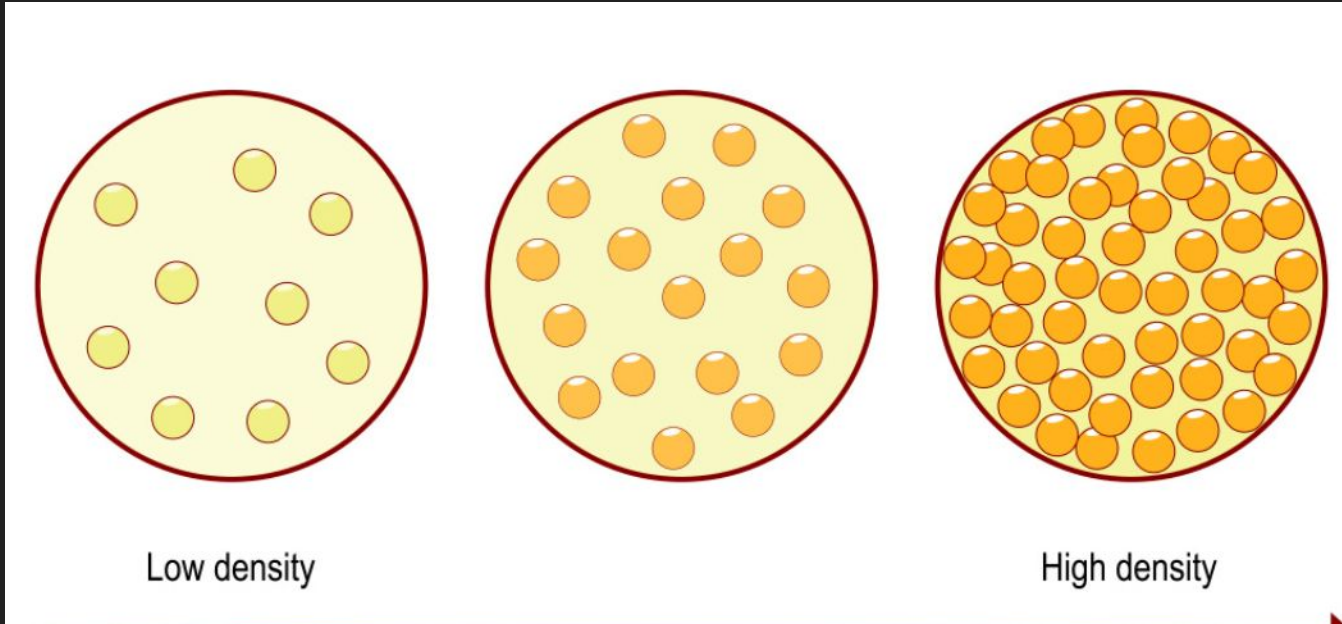
- Flow gas into the balloon
- Control the flow with a regulator
- Inflate to your target lift
- Safety matters!



# Matter... and Density

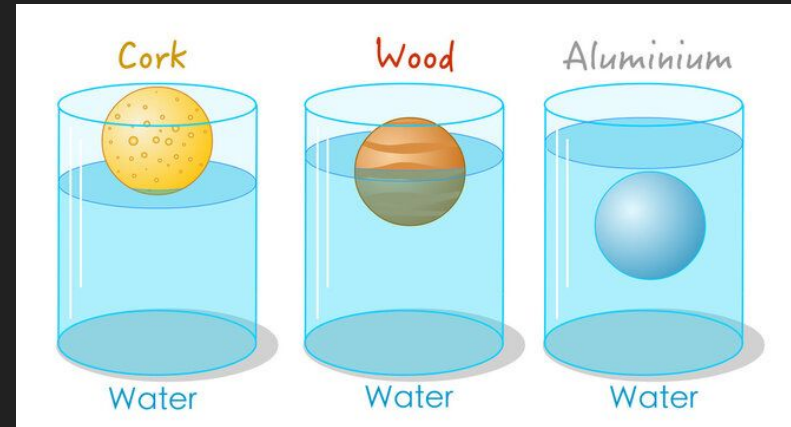
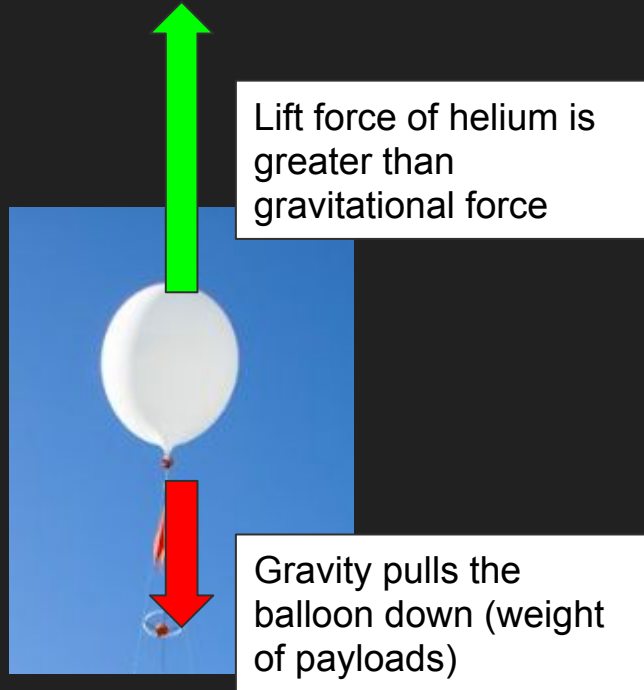
What is gas?

How tightly are molecules packed together?



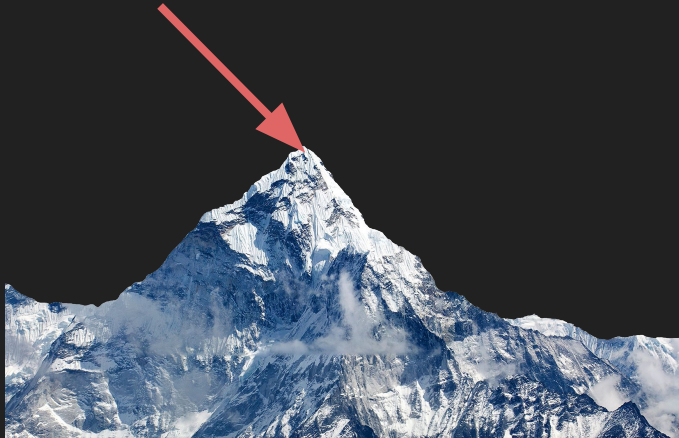
# How do balloons float?

## Forces



# Our Biggest Problem: *coming back down!*

Top of Mt. Everest



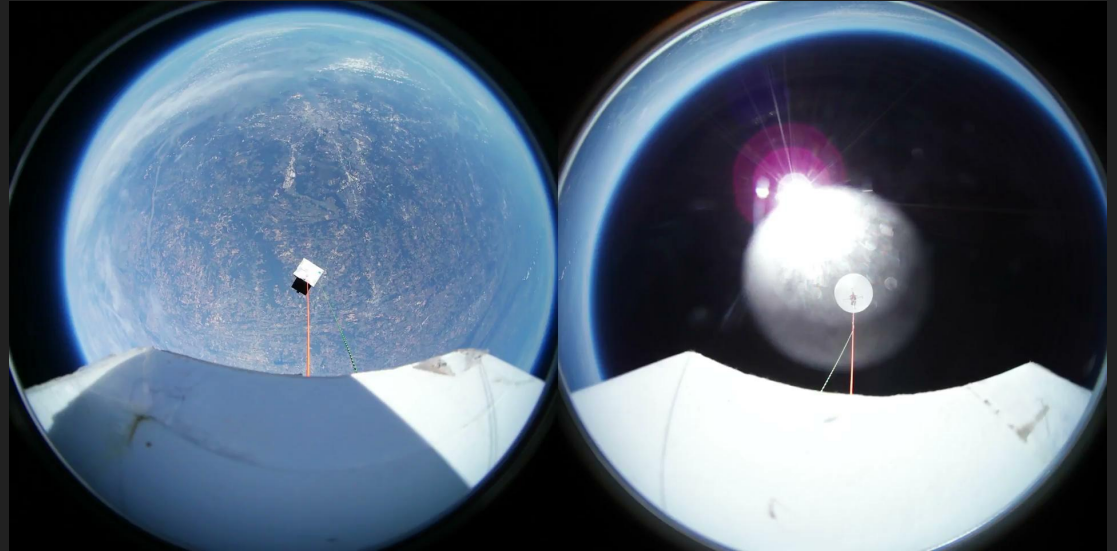
- Up to 150 miles per hour
- Could land on a rock!
- *Delicate scientific circuitry!!*

*How do we land safely?*

# Pop!

The balloon expands as it gets higher

Eventually, it cannot expand any more without breaking, so it pops!





# Descent and landing (Recovery)



- A parachute protects our equipment as it falls back to earth
  - Mission success!
- 
- Without air, the parachute wouldn't slow the fall



Wait... Parachutes need air to work?



# What is a Force?

Something that causes an object to change speed, called acceleration

- Gravity
- Your muscles
- The wind

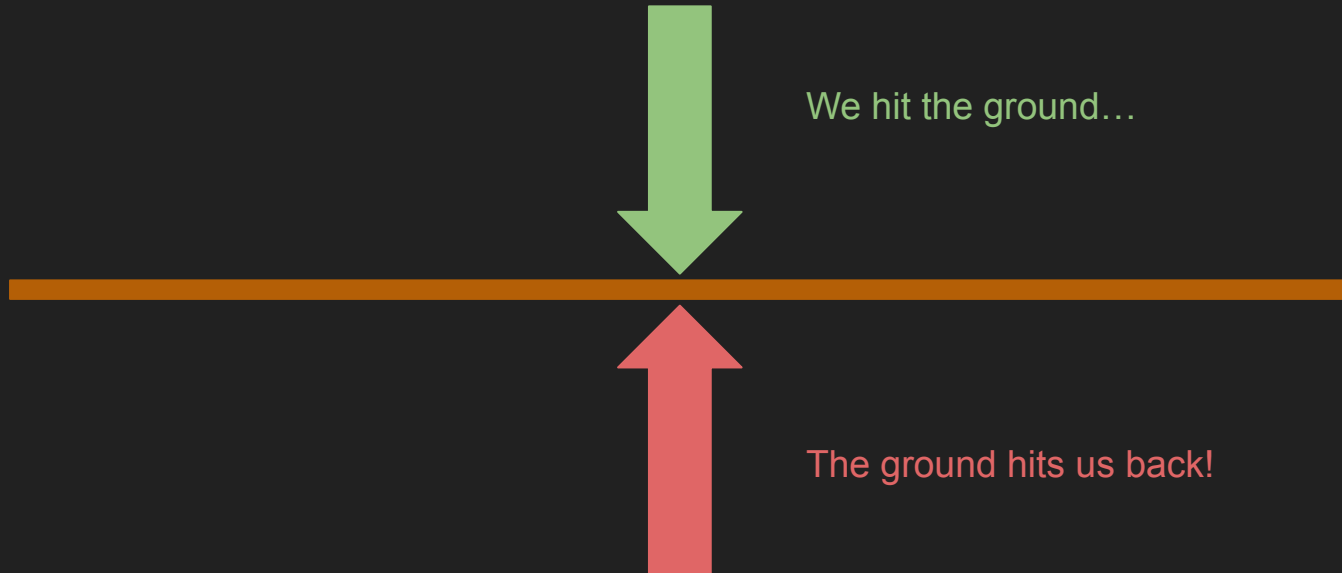
Force = mass x acceleration

What happens if two forces collide?



# Newton's Third Law

“Every action (force) has an equal and opposite re-action”



If one of these forces was stronger, what would happen?

# Serious Question

When you go skydiving...

Does the Earth's gravity pull you *down*

Or

Does your gravity pull the Earth *up*



# So how to we deal with Force?

1. Spread it out! (over space, or over time)

Seat Belt



Air Bags



# So how to we deal with Force?

2. Use it all up somewhere else!

Car bumper (absorbs force of impact)

It takes a lot of force to do this ----->



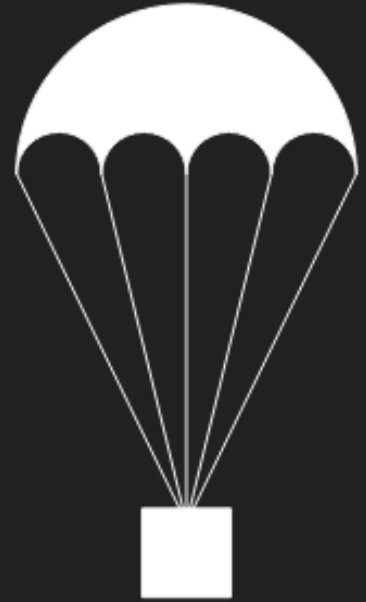


# So how to we deal with Force?

3. Have less force in the first place!

Parachute

(just go slower = less acceleration when you hit the ground)



# Workshop Time!

Design a device which will help your egg survive a drop from 3 meters (1 and a half people) high!

