

Defying Gravity!

FRAMEWORK

I. Scientific and Engineering Practices

II. Cross-Cutting Concepts

III. Physical Sciences

SKILLS/OBJECTIVES

- Understand nature of gravity
- How is gravity defied through physics
- Why do some things fall and others don't when they should?

MATERIALS

- Dixie Cups
- String
- Gummy bears
- Water
- Demo bucket
- Cup
- Hole puncher
- Printer paper
- Tape
- Paperclips
- Markers

- What is Gravity? How does it work and does it act all the time? Gravity is a force that pulls objects together. The more massive an object is the more gravity it has, so the gravity we feel is the earth pulling us downward. It's what makes us fall down if we trip, and keeps everything from floating away.
- What are some instances where people/things defy gravity? Does someone want to demonstrate a way they would defy gravity? For example: Throwing a baseball or a football, jumping, roller coasters that go upside-down, planes, spaceships and so on.
- We will explore some of these seemingly gravity defying instances through two activities.

Activity # 1	Upside-down spinning Bucket
Materials	Dixie cups, gummy bears, string, water, demo bucket, cup, hole puncher
Worksheet	Y/N

Procedure:

- 1) Split into groups of two, each group receives a dixie cup, two lengths of string, and gummy bears.
- 2) Punch four holes in the cup, one on each side and thread one the string straight across so it forms an X.
- 3) Tie the four lengths of string together at the top
- 4) When they have built their cups, demonstrate by spinning the bucket/large cup of water overhead
- 5) They should swing the Dixie cup upside down like demonstrated and the gummy bears don't fall out!
- 6) Confident students can move on to water instead of gummy bears maybe? Also they get to eat their gummy bears if they don't drop them.

Discussion:

- Isaac Newton's First Law of Motion: an object in motion will continue in motion in a straight line unless acted pushed by something else. This is known as **inertia**.
- The bucket is unable to travel in a straight line because it is attached to the so it swings in a circle instead.
- The water in the bucket is unable to travel in a straight line because it is stopped by the sides of the bucket. Therefore, as the bucket spins, the water remains inside
- Thus the inertia of the bucket is stronger than gravity. If you spin the bucket too slow, what would happen? The water would fall out because gravity would become stronger than the inertia.

Activity # 2	Airplanes
Materials	Printer paper, tape, paperclips, markers
Worksheet	Y/N

Airplane Wing Demonstration – In small groups/pairs:

- Using a half sheet of paper folded over a ruler, hold one of the short sides below your lips, and blow straight across, perpendicular to the floor. The paper will rise! This is part of how planes stay in the air.
- When we blow out, that air moves faster and has lower pressure than the slower air below the paper, so the sheet is “pushed” up by the difference in pressure.
 - Airplane wings are curved on top, the air above the wing must travel farther than the air below in the same amount of time, so it has to be traveling faster than the air below → Difference in pressure → **lift**

Next, have all the students build their own airplane! See instructions page on how to build them.

Post-Construction Procedure:

- 1) Have students line up and throw their plane in turns attempting distance, height, or whatever they want.
- 2) Once everyone has thrown once or twice they can go back and modify their plane with decoration and add-ons like paperclips, tape, and so forth.
- 3) First modification should be a paperclip on one side only and have them throw the plane. It might turn, or do a barrel roll or just fall sooner. This shows how a balanced weight distribution is crucial to keep planes flying.
- 4) Next add a paperclip to the other side balance the symmetry of the plane. It should fly better.
- 5) For another trial have them overweigh the front or back of the plane and see what happens then
- 6) Finish by letting them adjust their final plane in any way they want. And they can keep the planes of course.

7) During this process write awards to give to each student. Be creative, previous awards were things like longest throw, highest throw, loop-de-loop, crash landing, most improved, best design and so on.

Discussion:

- Planes generates lift to oppose gravity, for paper airplanes the source is the throwers hand
- Different shapes of planes will help or hinder the plane in maintaining this lift to glide through the air.
- Things like balance of weight and air drag, that we changed with the add-ons, are important to a planes ability to stay in the air.

CONCLUSIONS

What is gravity? – how is it involved in keeping the water in the bucket?

Gravity is a force in nature that attracts things to the earth. Thinking about that will make things clearer!

How does a plane stay in the air? What is lift and drag? Do planes defy gravity?