Defying Gravity!

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| FRAMEWORK |  |
| I. Scientific and Engineering Practices | |
| II. Cross-Cutting Concepts | |
| III. Physical Sciences | |

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| SKILLS/OBJECTIVES |  |
| o Understand nature of gravity  o Why do some things fall and while others don’t?  o Understand how forces from the air can counter the force of gravity.  Learn to make and fly paper airplanes. | |

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| MATERIALS |  |
| * Demo bucket * Inertia contraptions (they’re just small pieces of cardboard with strings attached) * Small cups (like medicine cups) * Water * Printer paper * Tape * Paperclips * Markers | |

**INTRODUCTION**

* 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, airplanes, helicopters, spaceships, helium balloons.
* When something defies gravity, does gravity stop pulling on it, or is there something else that is pushing on it harder?
* We will explore some seemingly gravity-defying instances through two activities**.**

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

**Procedure:**

1. Put a small amount of water in the large bucket. Make sure all the kids know that there’s water in there, and then spin the bucket around and around.
2. Ask them to come up with an explanation, or hypothesis, of why the water doesn’t splash everywhere while the bucket is spinning.
3. Split into 2 or 3 groups. In each group, place one of the small cups on the piece of cardboard with strings attached.
4. Allow the children to take turns swinging the contraption and observe that the cup does not fall off the cardboard stage, even when it is upside-down overhead.
5. Confident students can try adding water to the small cups. Just note that it might be messy if the cup goes flying when they try to stop!

**Discussion:**

* (Isaac Newton’s First Law of Motion) We know that a moving object will keep moving in a straight line unless something else pushes it.This is known as **inertia**.
* The bucket wants to travel in a straight line, but we aren’t letting it. We are forcing it to spin around, so it travels in a circle instead.
* The water in the bucket wants to travel in a straight line the same way the bucket does. But it too 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.
* So, the inertia of the bucket is stronger than gravity. What would happen if you spun the bucket too slow? The water would fall out because gravity would become stronger than the inertia.

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

**Airplane Wing Demonstration** – In small groups**:**

* This is trickier than it seems, so maybe practice once or twice before you show the kids. Tear a piece of paper in half, long-ways. Hold short end of the paper below your lips, and blow straight across the top, parallel to the floor. The paper should 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.

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.

1. During this process, you might want to think of 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:**

* The air exerts a lift force on airplane wings that opposes gravity.
* 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 can things go up when gravity is pulling them down?

Gravity pulls downward on everything, but sometimes other forces are stronger than gravity and things don’t fall.

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