

# FUTURE U.

## Smooth Sailing: Miami Flight Training Center

### Materials Store:

- Drinking straws
- 3" x 5" index cards
- 4" x 6" index cards
- 5" x 8" index cards
- Scissors
- Individual Tape Dispensers (such as Scotch Tape)
- Rulers

### Overview

In this challenge, student teams will use their understanding of the forces of flight to build hoop gliders. They will compete to see who can create a hoop glider that flies the longest distance, and they will participate in a class discussion around the science behind their creations.

### Educator Prep

- Review the Introduction Video.
- Review the other pages included in this activity packet.
- Complete the classroom setup below prior to the session.

### Classroom Set-Up

1. Set up and review the **Materials Store**. Ensure there is enough of each item for each team.
2. Select an area where students can perform their flight tests. Try to choose an area with at least 40 feet of flying room. The length of your classroom, a hallway, or a section of your cafeteria, auditorium, or gymnasium could work well. To avoid the effects of wind, indoors is best.
3. Once you have a location, use painter's tape (at least four or five feet) to mark where students should stand when they fly their hoop gliders in order to maximize the flying space in front of them. Call this line the *runway*!
4. Set up the Teams Tables with the following items:
  - Team Roles + Salaries sheet
  - Role Handouts
  - Engineering Planning Guide
5. Divide students into teams of five people. Each person will have a specific role. If some teams have six people, a second aerospace engineer can be added.

Example Team Roster

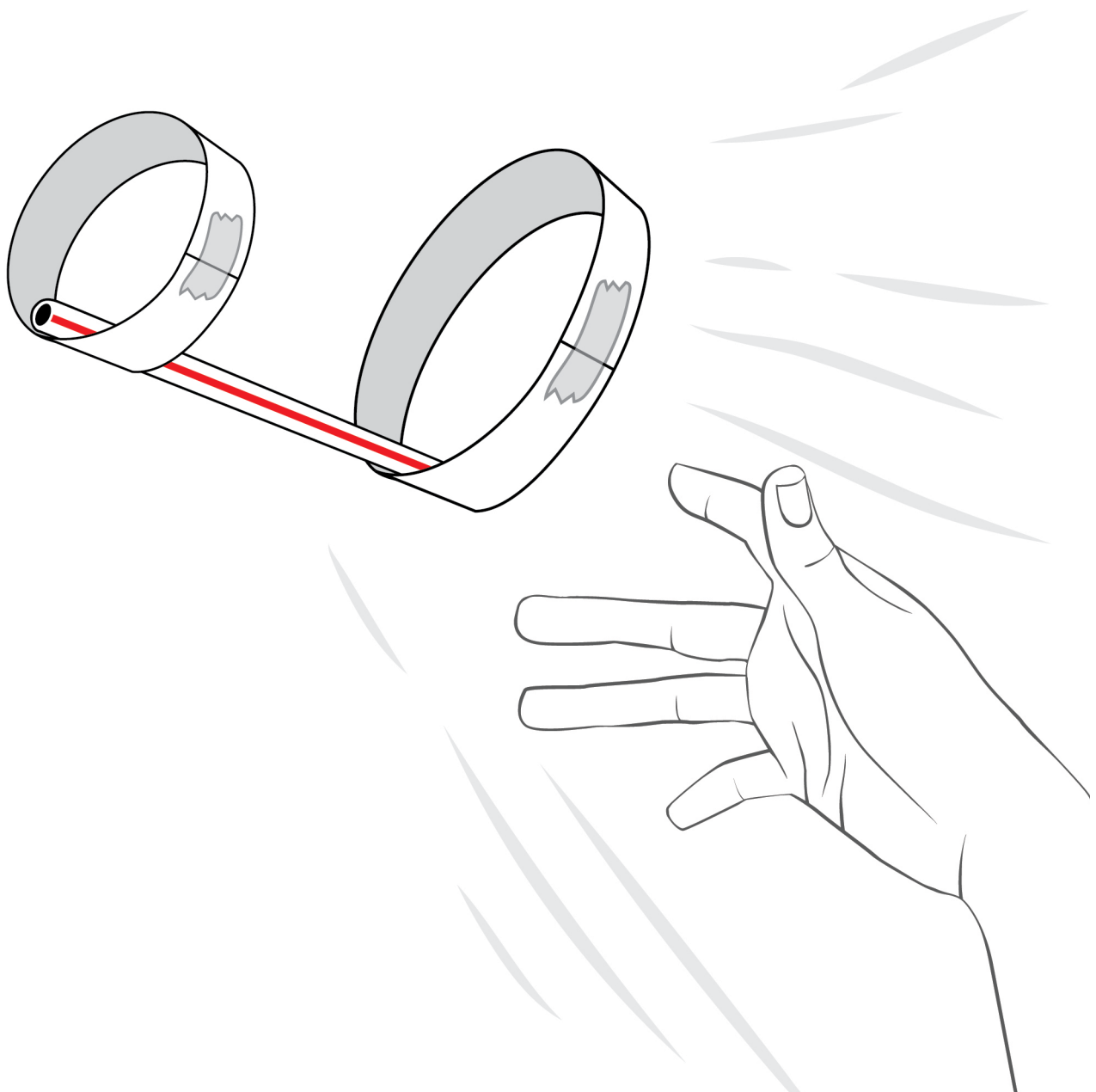
Finance manager	
Materials manager	
Aerospace engineer	
Aerospace engineer 2	
Mechanic	
Pilot	

## Student Introduction

In this activity, you will work in teams as you apply your understanding of the forces of flight to build a hoop glider. After building a glider that consists of at least one hoop, you will take turns flying your glider from a set location. The glider that travels the farthest distance wins!

Each team member will have a role to play as you experiment with different hoop glider designs to determine which one best balances the four forces of flight to fly the farthest.

Once you have had 15 minutes to plan with your team and perform your roles, the flying challenge will begin!



# Team Roles + Salaries



## **Finance Manager: \$3,500**

Responsible for the budget



## **Materials Manager: \$3,000**

Responsible for the purchasing and inventory of the supplies



## **Aerospace Engineer: \$4,000**

Leads the group through completing the Engineering Planning Guide



## **Mechanic: \$3,000**

Builds the glider



## **Pilot: \$3,500**

Tests the glider, reports issues, and suggests modifications



## Materials Manager: Cost Sheet

Items	Cost
Drinking straw	\$10,000/each
3" x 5" index card	\$3,000
4" x 6" index card	\$4,000
5" x 8" index card	\$5,000
Scissors	FREE
Ruler	\$5,000
Tape	\$1,000
First test flight using the runway	FREE
Additional test flights	\$5,000/each

## Finance Manager: Budget Sheet

Items	Starting Budget: \$55,000
Finance manager salary	\$3,500
Materials manager salary	\$3,000
Aerospace engineer 1 salary	\$4,000
Aerospace engineer 2 salary	
Mechanic salary	\$3,000
Pilot salary	\$3,500
Drinking straw(s)	
3" x 5" index card(s)	
4" x 6" index card(s)	
5" x 8" index card(s)	
Scissors	FREE
Ruler	
Tape	
First runway trial	FREE
Additional runway trials	
<b>Ending Balance:</b>	<b>\$ _____</b>



## Aerospace Engineer Instruction

In this activity, your hoop glider will be able to fly well if you are able to successfully balance the following four forces of flight:

- **Thrust** is the force that moves an airplane forward. It can be created by an engine or the force of your arm.
- **Drag** is the force that slows down an airplane and works opposite to the direction of a plane's motion. It is caused by air pressure and friction.
- **Weight** is the force caused by gravity, which can push a plane down. The heavier your plane, the more weight it has.
- **Lift** is the force that helps hold an airplane up in the air. It can be created by an airplane's wings.

Today, you and your team will focus on creating this balance as you compete against other teams to create and throw a hoop glider that can fly the greatest distance.

Your role is to lead your team through completing the Engineering Planning Guide. You will work with your team members to design a hoop glider, which must consist of at least one paper hoop (or loop) and one straw. The goal is for your hoop glider to fly farther than the others when thrown by a member of your team. Your hoop glider's landing location will be marked, and the team whose glider lands farthest will win.

You may use any of the materials available to you as long as they are within your budget.



## Mechanic Instructions

Work with your teammates to build and carry out a design that will enable your hoop glider to fly farther than the others.

Your hoop glider has two criteria:

1. It must contain at least one paper hoop (or loop/circle).
2. It must use at least one straw.

It is your job to help construct the hoop glider, analyze its performance during the test flight(s), and repair, enhance, and tweak the design as needed until it is ready to takeoff.



## Pilot Instructions

Work with your teammates to build and carry out a design that you believe will enable your hoop glider to fly farther than all the others.

It is your job to help test your design(s), provide feedback on the trial run(s), and throw your hoop glider during the final competition.

As the pilot, be sure to remind your teammates that it is important to consider how the hoop glider should be thrown. While its design is crucial, *how* it is flown is important as well!



**Directions:** Follow the steps below to prepare for the hoop glider flight challenge. Make notes as you discuss your answers together.

▶ **Ask:** What is the problem we are trying to solve?

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▶ **Imagine:** How can we solve this problem? Brainstorm solutions.

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▶ **Plan:** Select one or two solutions you think will work best and explain how they will solve the problem.

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▶ **Create:** Design and build your prototype.

▶ **Test:** What worked? What didn't work?

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▶ **Improve:** How could you make your design better? Make these changes.

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▶ **Share:** Be ready to discuss what you have learned!

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Each group of students is unique. In addition to the hoop glider that flies the farthest distance, you may also choose other ways to judge your groups based on their grade level, your learning focus areas, and the resources available.

**Additional judging criteria may include the following:**

- \_\_\_ correctly completed Math on the Budget sheet
- \_\_\_ most innovative design
- \_\_\_ least amount of materials
- \_\_\_ least amount of money spent
- \_\_\_ completion of the Engineering Design Planning Guide
- \_\_\_ \_\_\_\_\_
- \_\_\_ \_\_\_\_\_
- \_\_\_ \_\_\_\_\_

Once you have selected multiple judging criteria, assign one point to each item above to see which group(s) have the highest number of points.



**Directions:** Conclude with a discussion to wrap up the session:

▶ **Ask:** What created the thrust, drag, weight, and lift for your hoop glider's flights?

▶ **Recap:**

- The hoops helped create lift.
- Drag was created by air pressure but could be reduced by creating an aerodynamic shape.
- Gravity eventually pulled the glider to the ground.
- Thrust was created by your arm.

▶ **Ask:**

- What designs seemed to have the most success? Why?
- Which throwing method seemed to have the most success? Why?
- What lessons did you learn about the forces of flight?

▶ **Discuss** as a full group.

▶ **Explain:** Recap and help students understand that when an airplane flies, the engine must provide enough thrust to overcome the airplane's drag *and* the wings must provide enough lift to overcome the airplane's weight. When these forces are balanced, an airplane can easily fly until it reaches its destination!