PRINCIPLES OF FLIGHT CHALLENGE

GRADE LEVEL: 3–8

OBJECTIVES:

To increase ability to:

- design and redesign
- generate creative solutions to problems
- make sound judgments and form conclusions
- understand the physics principles involved in flight
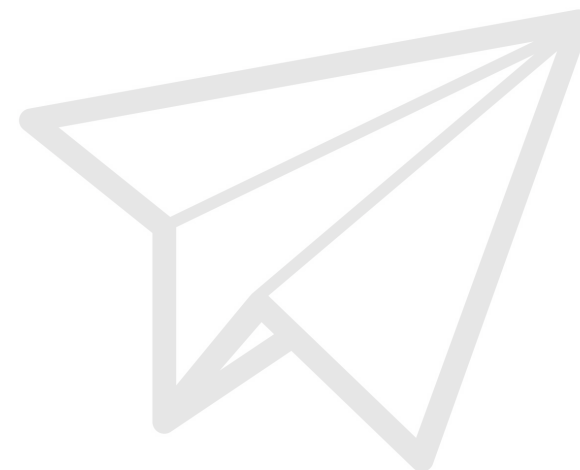
TIME: 50 minutes

MATERIALS:

- Plain white paper – 5 sheets per participant, 3 for instructor
- 1 pre-made paper airplane
- Paper clips – Up to 10 per youth
- Pencil – 1 per youth

IMPLEMENTATION NOTES:

- This activity is designed to help youth learn about the physics of flight through experimentation and engineering design. Youth will be expected to design, test, and redesign their projects in order to meet different criteria.

- Youth will be learning concepts through demonstration, and then solidifying their understanding of those concepts through inquiry based learning experimentation.

PREPARATION (before the session):

1. Separate paper and paper clips into groups of five sheets and ten paperclips.

2. Set materials in a place that is equally accessible for all youth.

3. Ensure facilitator has sheets of paper on hand for demonstration purposes.

At the Y, we believe in a holistic approach to youth development so that all children reach their full potential and become competent and healthy adults.

Submitted by: YMCA of Northern Utah

1. ENGAGE AND CONNECT

🕐 **2 MINUTES**

Ask:

- Who has been on an airplane or something that flies? This could be a helicopter, blimp, or paraglider. Who is able to describe that particular aircraft? Does anyone know why these devices are able to fly?

- Have several youth come to the front and draw airplanes. When the youth have finished, ask: What is the same about these drawings of airplanes? What is different? Today we will be talking about the principles scientists and engineers have to consider when designing aircraft!

2. INTRODUCTION AND SET UP

🕐 **8 MINUTES**

Communicate the following:

- The **first principle** of flight we will be talking about today is **lift.**

  Introduce and demonstrate the concept by doing the following: Hold up paper airplane. Ask youth if they can guess what lifts the paper airplane into the air. Brainstorm ideas, guiding discussion to the wings. The wings on an airplane create lift – lift is created when the wings cut through the air. Some of the air flows underneath the wings, and some flows over the wing and this causes the plane to lift itself into the air.

- The **second principle** of flight is **weight** (or **gravity**).

  Introduce and demonstrate the concept by doing the following: **Weight** is what counteracts **drag**. Crumple up a piece of paper and ask youths what direction the paper will go when dropped (youths should answer "down"). Drop the paper – it falls down because the object has mass and weight, and is therefore affected by gravity! We will be giving our planes more weight by adding paperclips to our plane designs. In order to fly, the lift needs to be greater than or equal to the weight!

- The **third principle** of flight is **thrust**.

  Introduce and demonstrate the concept by doing the following: Thrust is what moves the airplane forward. Thrust in an airplane is usually generated by jet engines, or by a propeller. In paper airplanes, thrust is commonly generated by the person throwing the plane! Have a youth move to the front and throw the pre-made paper airplane with a lot of force, and then with a little bit of force. Ask youths which throw generated more thrust (the more forceful throw).

- The **fourth principle** of flight is **drag** (or **air resistance**).

  Demonstrate drag by doing the following: Have two youths come to the front of the class. Give each youth a piece of paper and tell them to hold it to their chest. Instruct them to run across the room, and let go of the paper when they are halfway to the other side. When the youth lets go, the paper will stay on the youth's chest even though they are not holding it. This phenomenon is due to the principle of drag.

- Introduce the challenge and materials:

  - **Create a paper plane that can fly from one end of the room to the other, holding as much weight (paperclips) as possible.**

3. QUESTIONING/REASONING

🕐 **30 MINUTES**

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To begin the challenge, give each youth a copy of the design template. Encourage youth to sketch their original plane design idea on the design template. Once youth are ready to build, allow them to use the materials while asking the following questions to help facilitate learning:

- How does your airplane generate lift? How could you generate more or less lift?
- How do you ensure the lift of your airplane is equal or greater than the weight acting on the airplane?
- Will you have to change the wings when you add more weight to your airplane?
- What is your source of thrust?
- How have you designed your airplane to have the least amount of drag?

15 minutes in:

Tell youth to make their final adjustments. Have youth throw their airplanes across the room with as many paperclips attached as possible. Ask questions during the test:

- Why was your airplane successful?
- What could you change about your airplane to make it go farther?
- What could you do to increase the thrust or lift in your airplane?
- Do you think you could add more weight?

After all youth have tested, encourage them to fill out the final part of their design worksheet (up to 5 minutes). After the second part of the sheet is filled out, youth are welcome to redesign or change their airplane and retest. Allow youths to retest and make changes to their airplanes (10 minutes).

4. REFLECTION

🕐 **10 MINUTES**

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Invite youth to leave their own designs and walk around the room to observe peers' designs. Then, instruct them to return to their seats and process the activity by asking:

- What was something most designs had in common?
- What was a creative design feature a peer created?
- Which airplane had the most lift?
- How was thrust generated in these airplane designs?
- Which design was able to hold the most weight? Why?
- What was challenging about this activity?
- What was your greatest success in the activity?
- What does this tell you about is going on when you are in an airplane?