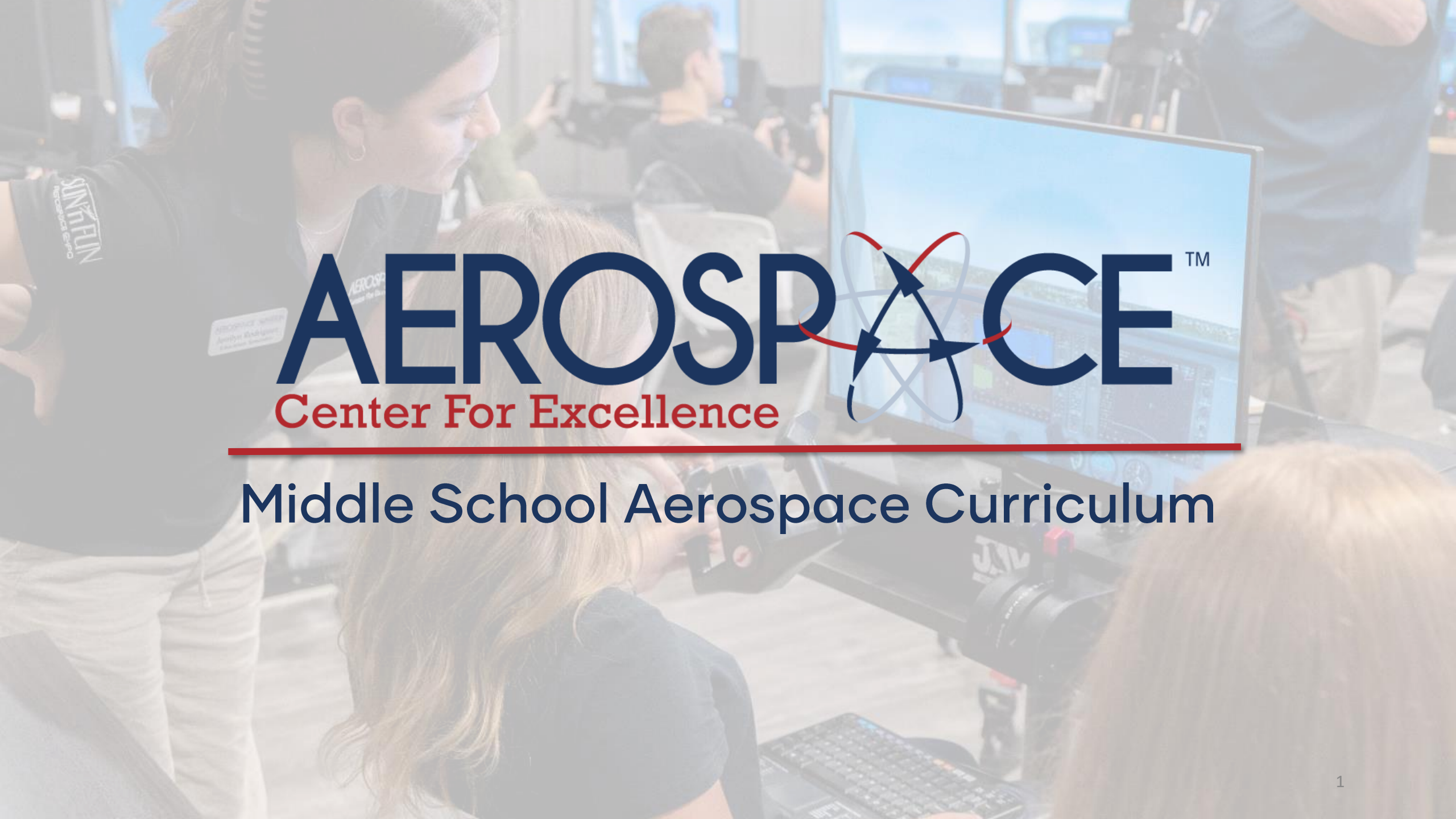




AEROSPACETM

Center For Excellence

Middle School Aerospace Curriculum

POWER TO FLY

UNIT 3 | LESSON 3 | PRESENTATION

Lesson Overview

In this lesson students will explore the four forces of flight and explain how the different types of engines help aircraft to stay in the air.

PROPRIETARY

Learning Objectives

The Learner will:

- Identify the four forces of flight.
- Explain how the different types of engines interact with other systems to keep an aircraft in the air.

Flying Failures

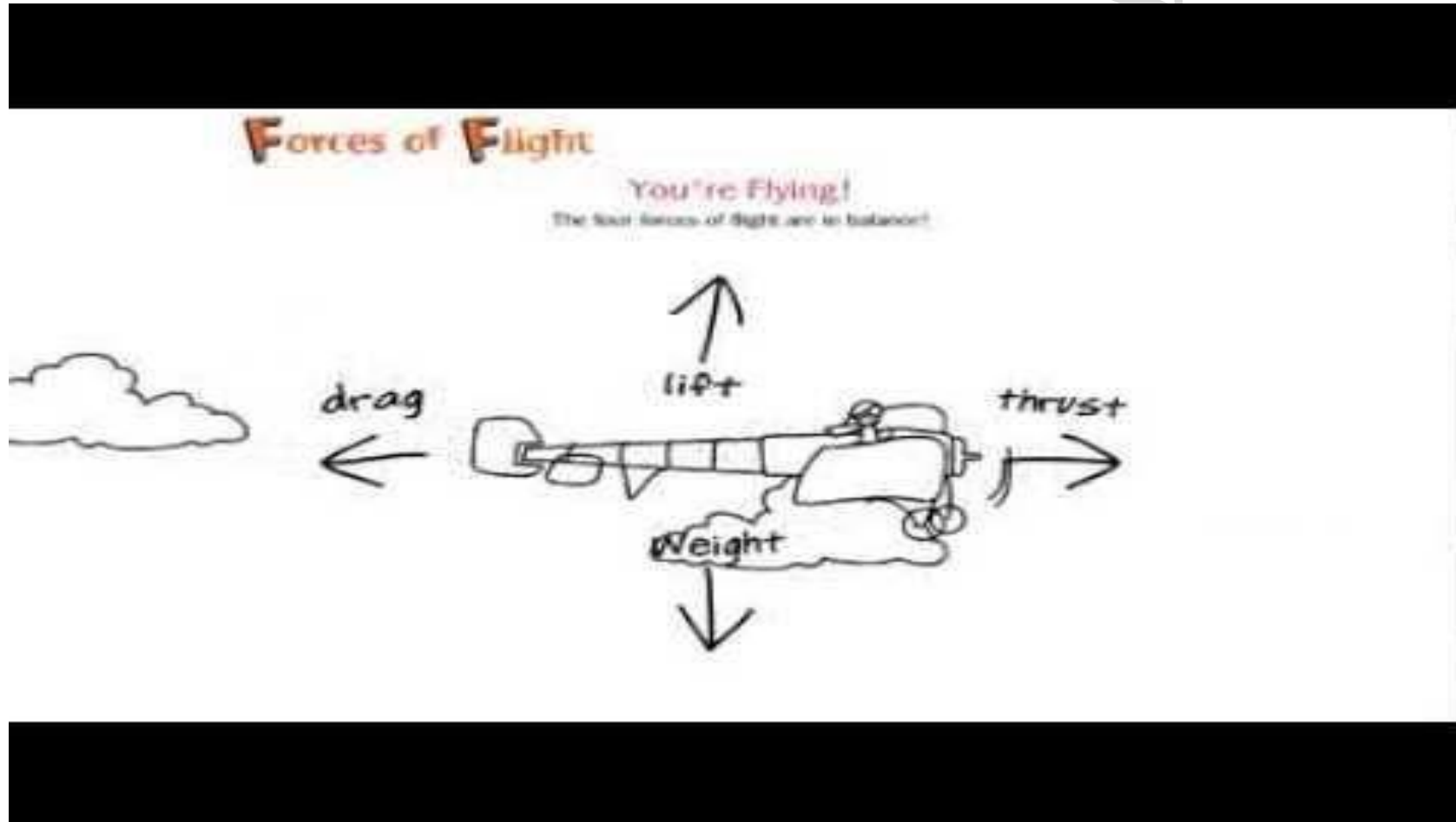


Power to Fly?

What does it take to get this jet in the air?

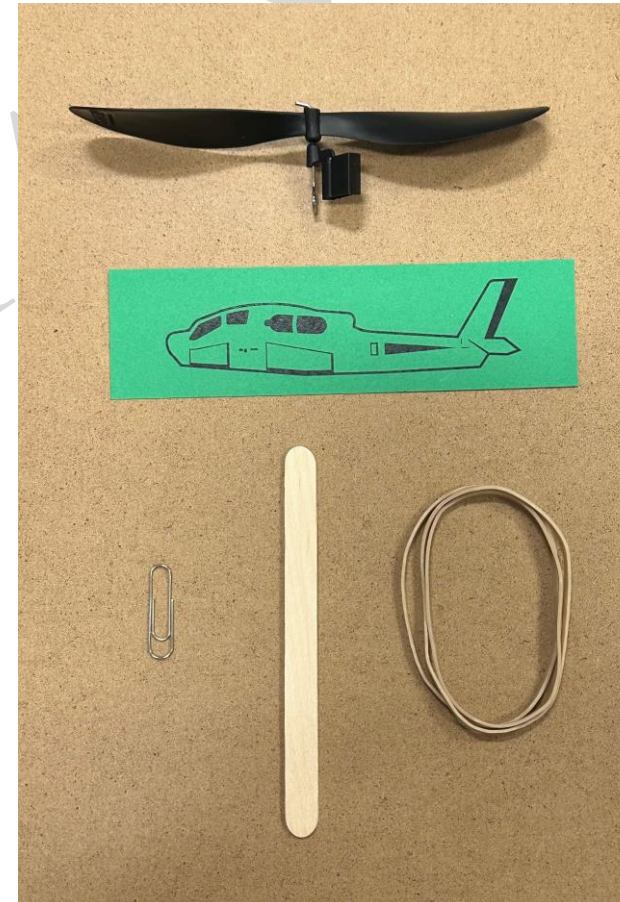


Forces of Flight



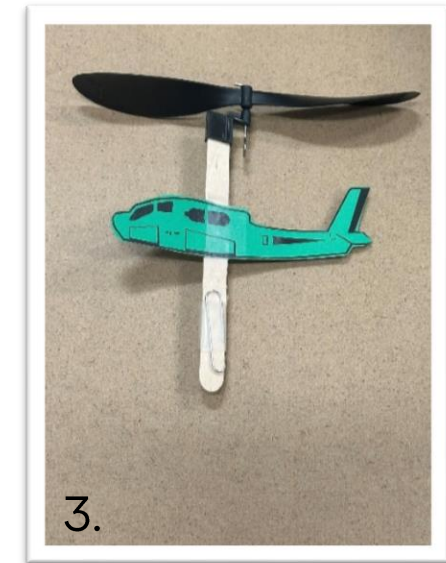
Materials: Helicopter Flight

- 1 Plastic propeller
- 1 Craft stick
- 3 Rubber bands
- 1 Small paper clip
- 1 Helicopter outline
- Tape
- Scissors



Build Helicopter

1. Bend the paper clip and tape the larger end of the paper clip to one end of the craft stick as shown.
2. Insert other end of the craft stick into slot on bottom of propeller.
3. Cut out helicopter shape and tape helicopter shape to craft stick on opposite side of paper clip.

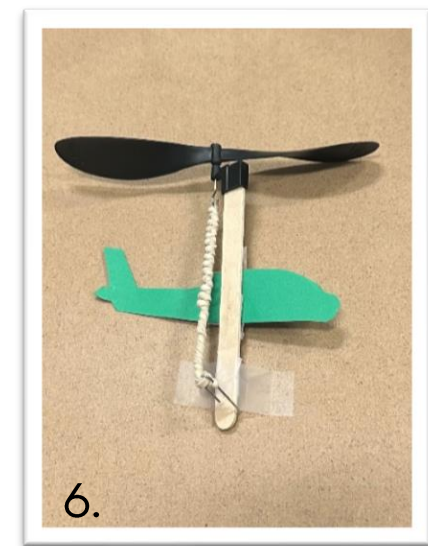


Build Helicopter Continued

4. Attach one rubber band to the clip on the propeller and the other end to the paper clip.

5. Wind the rubber band by holding the craft stick in one hand, face the propeller towards you and with your index finger start winding the propeller clockwise.

6. You will see the rubber band twisting. Keep going until the rubber band has twisted back on itself all the way down (about 60 times – maybe a little more).



Fly Helicopter and Record Data

6. Fly the propeller using the following steps
 - Face the propeller up.
 - Let go of the propeller and craft stick as you say the words, "Let's Go". You should release the propeller on the word "Let's" and the craft stick on the word "Go".
7. Make observations about the flight including relative distance, direction, etc.
8. Repeat Steps 4-7 using 2 rubber bands and then 3 rubber bands.



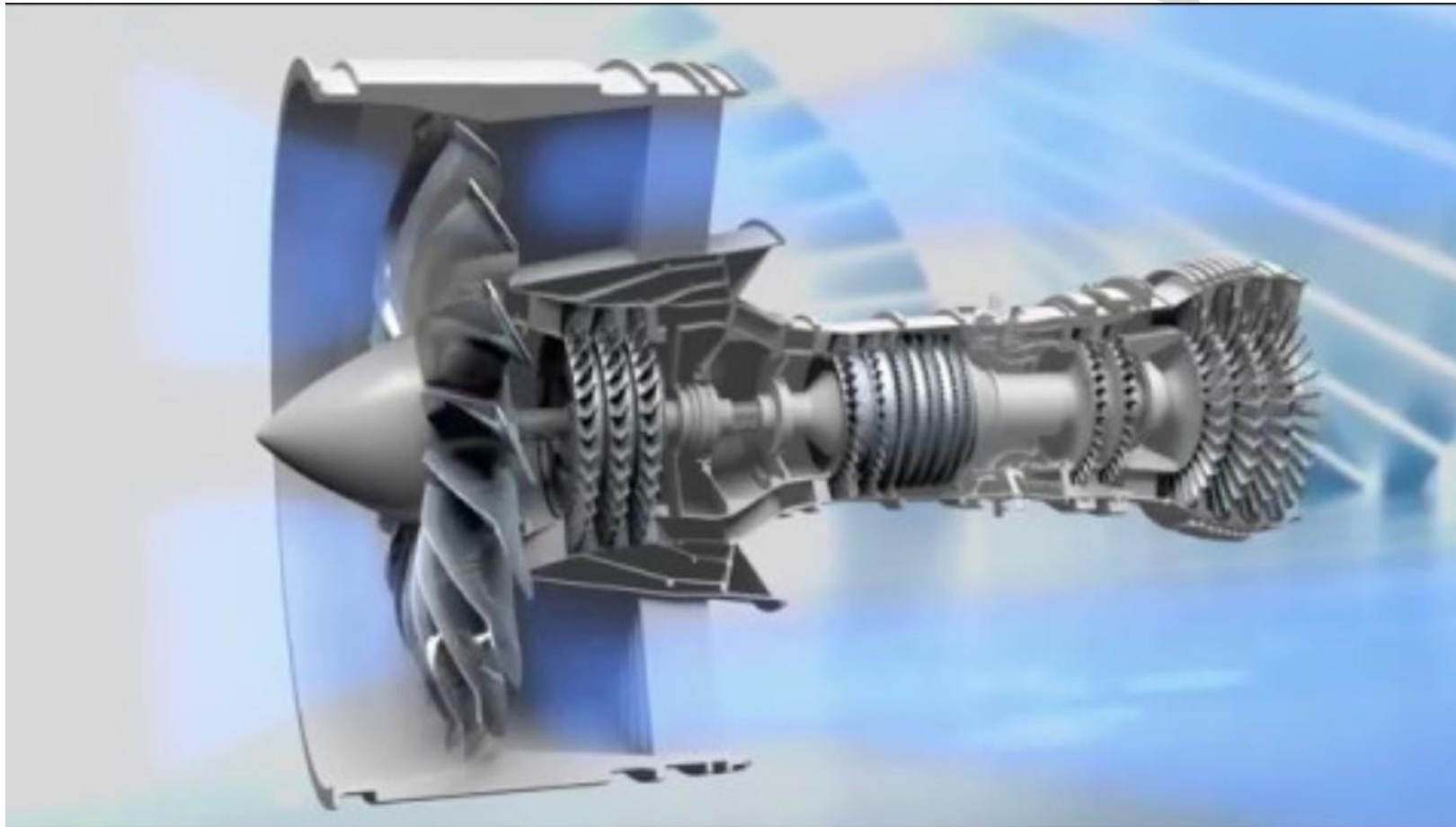
Activity Questions

1. How was energy stored in this helicopter?
2. How was power provided to move the helicopter? What force is this?
3. How was lift produced?
4. How was drag produced?
5. How did the flight change as you added more rubber bands? Why?
6. What force would be impacted if you cut the body of the helicopter thinner or shorter?
7. What impact do you think this would have on the overall flight of the helicopter?
8. Cut your helicopter body and test it. What did you observe? Explain why you think this happened.

Reciprocating Engines



Reciprocating Engines



Four Forces of Flight

Label each of the pictures showing the direction and name of each of the Four Forces of Flight.



Power Systems



Engineering Design Process



Engineering Design

1. **Problem:** Design a personal flying vehicle.
2. **Criteria:** Include each of the following:
 - a. Drawing of vehicle design and reason for choosing that design.
 - b. Identification of power source and reason for choosing it.
 - c. Identification of the four forces of flight on drawing.
 - d. Identification of how lift will be produced.

References

ERAU SpecialVFR. (2016, September 9). *Aircraft systems - 03 - engine*. [Video]. YouTube. <http://www.youtube.com/watch?v=gldXLMVP6VU>.

The Film Gate. (2019, September 24). *Flying failures | stock footage*. [Video]. YouTube. <http://www.youtube.com/watch?v=Je8wxnoEkug>

Johnston, M.A. (2023). *Thrust and Newton's third law in aviation*. California Aeronautical University. [https://calaero.edu/newtons-third-law-in-aviation/#:~:text=The%20airfoil%20\(wing\)%20pushes%20air,to%20lift%20\(Bernoulli's%20Principle\)](https://calaero.edu/newtons-third-law-in-aviation/#:~:text=The%20airfoil%20(wing)%20pushes%20air,to%20lift%20(Bernoulli's%20Principle))

Pratt & Whitney (2017, August, 18). *How jet engines work*. [Video]. YouTube. <http://www.youtube.com/watch?v=x8DK4rM6Y90>

Smithsonian Education. (2014, March 11). *Forces of flight*. [Video]. YouTube. <http://www.youtube.com/watch?v=CKrvYCOSbf8>

STEM Inventions. (2017, October 28). *Young engineers: How to make rubber band helicopters - engineering projects for kids*. [Video]. YouTube. <http://www.youtube.com/watch?v=DiJlvoHvGk4>