LESSON 1

Name: _____ School: _____

AIRPLANE ENGINEERING – How do they Fly?

Make and Test a Variety of Paper Airplanes

TIME: 30-60 Minutes

MATERIALS:

1. Paper (8.5" x 11" is best)
2. Paper Clips (optional)
3. "Fold'N Fly" paper airplane designs: https://tinyurl.com/mesa-paper-plane

VOCABULARY:

- Aerodynamics
- Drag
- Gravity
- Thrust
- Lift

OBJECTIVE:

Students will build and test a variety of paper airplanes and explore the ***Four Forces of Aerodynamics***.

INTRODUCTION QUESTIONS:

1. When an airplane flies in the sky, how is it possible? How do you think such a large, heavy object can stay in the air?

2. Do you think different physical properties like wing size, weight of the plane, and size of the tail can affect how efficiently it flies? Why or why not?

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BACKGROUND INFORMATION:

Aerodynamics *- The properties of a solid object regarding the manner in which air flows around it.*

- Aerodynamics refers to how easily an airplane moves through the air.

Drag *– A type of friction that causes air resistance. It is a force that acts opposite to the relative motion of an object.*

- Drag happens when the air resists the forward motion of an airplane, slowing its velocity. When building a plane, you want to create as little drag as possible.

ACTIVITY!

Demonstration: Hold your hand in front of you so that your hand is in front of you, with the thumb pointing up, as if you are going to shake someone's hand. Notice the amount of air pushing against your hand.

Now turn your palm so that it faces the ground. Your hand will be horizontal and parallel to the ground. Swing your hand back in the same manner, as if you're slicing through the air. You should be able to still feel air, but should also notice that your hand moves more smoothly than when it was turned vertically.

Gravity *– A force that attracts two bodies toward each other. The more mass an object has, the stronger its gravitational pull.*

- Gravity is the force that will pull a paper airplane to the ground.

ACTIVITY!

Demonstration: Put a paper clip on the edge of a piece of paper. When you drop it, how quickly does it fall to the floor? Now remove the paper clip and drop the paper. How does it fall differently?

- When the paper has less mass (without the paperclip), the less it needs to fight against gravity pulling it to the ground.
- How does drag also affect its fall to the ground?

Thrust– *Thrust is a force or a push, when a system pushes or accelerates mass in one direction, there is an equal thrust in the opposite direction.*

- An airplane's engine generates thrust. When flying a paper airplane, the thrust is created by the forward push of the arm.

Lift *– A force that directly opposes the weight of an airplane and holds it in the air.*

- *An airplane's wings push UP harder than the air above it is pushing down. This means it is the wings that are doing the lifting, not the engines or thrust.*
- *The wings are often slightly curved so the air can move more quickly over the top than the air moves below the wing, creating an upward lift.*

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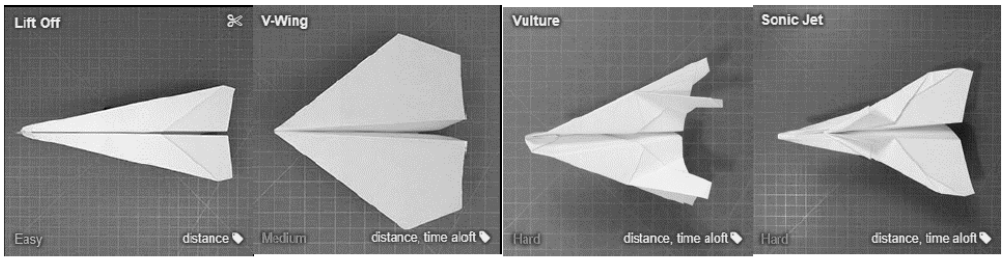
ACTIVITY!

Demonstration:

Fold two different paper airplanes of your own creation and take them outside. Maybe one has large wings and the other has narrow wings. Try some test flights, starting with a smooth steady throw, then gradually increasing the force of your throw (thrust).

- Do you notice a difference when you increase the thrust?
- Did the large winged plane stay in the sky longer, while the one with narrow wings went farther? How does this relate to lift and drag?



BIG ACTIVITY!

NOW LET'S HAVE SOME FUN BUILDING EXPERT PAPER AIRPLANES!

- Check out these online plans and build as many as you'd like: https://tinyurl.com/mesa-paper-plane
- Take your planes outside and create your own testing parameters to test for lift, drag, thrust and aerodynamics.

BACK INSIDE: FOLLOWUP QUESTIONS

1. Describe the testing procedure that you set up. Were you able to measure lift, drag and thrust? How about distance and time?

2. Which airplane flew the farthest? Why?

3. Which airplane flew the fastest? Why?

4. Which plane was your favorite? Why?

Bonus Video (How This Guy Folds and Flies World Record Paper Airplanes):
https://www.youtube.com/watch?v=3BNg4fDJC8A

Have fun exploring the exciting world of physics and the magic of flying! Get some fresh air and exercise!!

"Quite likely the twentieth century is destined to see the natural forces which will enable us to fly from continent to continent with a speed far exceeding that of a bird."

-Simon Newcomb

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