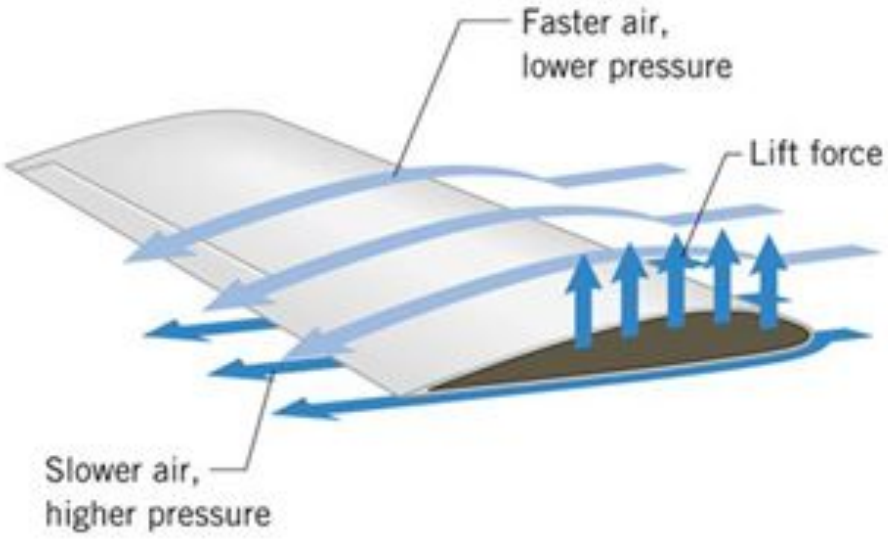
# Cumberland County
# Summer STEM Challenge Week 3

For this week, we'll investigate and design the best paper airplane we can. I've included four designs and folding instructions to get you started, then your job is to design and fly the best plane you can come up with on your own!

**Background:**

Airplane isn't quite the right word to describe what we're making today. Since it lacks a propulsion system, the more "correct" word would be glider. HOWEVER, paper airplanes share many of the same parts as real airplanes.

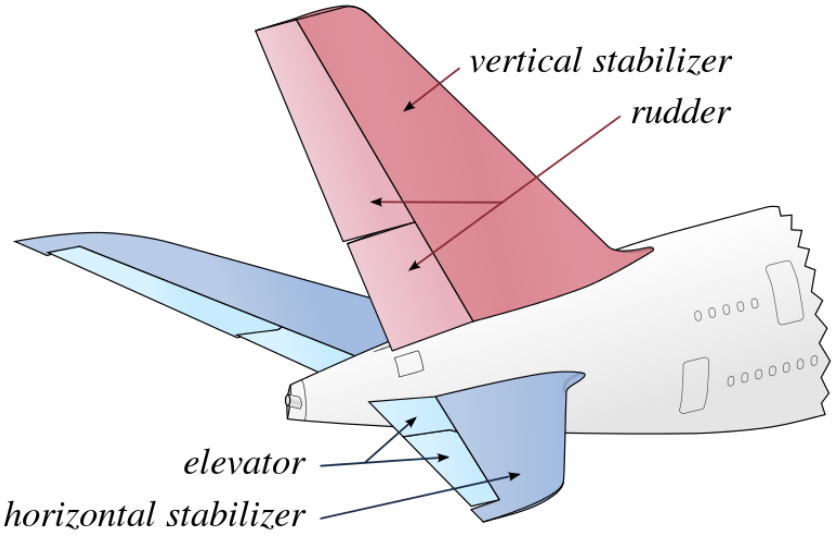
You'll need **wings**. A wing provides the lift to counteract gravity and keep your plane in the air. Typically, wings have an easily recognizable shape that is easy to forget about in paper form.




As the wing cuts through the air (in this case the plane would be flying towards the right, the air is flowing from right to left), the faster moving air across the curved top surface is at a lower pressure than the air below the wing. One of the mistakes you can make when making a paper airplane is making that fold that forms the leading edge (front) of the wing too crisp and flat. The top of the wing should be gently curved, the bottom of the wing should be flat.

You need to make sure that you have **balanced the lift** your wing (or wings) generate from left to right. If your airplane has a larger wing on one side, that wing will generate more lift, bringing that side up and the other side down. Your plane will spiral out of the sky and crash. Also, planes with wings tipped slightly upwards (somewhere between an uppercase T and an uppercase Y) tend to automatically level themselves from left to right.

You'll also need some kind of **vertical stabilizer** or tail**.** The vertical (meaning it sticks straight up or down) stabilizer keeps the plane from randomly flying to the left or the right. Looking at the photo below, you might realize that many paper airplanes have their vertical stabilizers underneath the plane instead of sticking out of the top of the plane. While this won't work on a "real" airplane, it performs the same action on a paper airplane. The trailing edge (back) of the vertical stabilizer is the **rudder** that allows the plane to turn from left to right. (This is called yaw in aeronautical terms.) You can tweak the back edge of the vertical stabilizer to make your plane turn left or right. Keep in mind that whatever adjustment you make won't change as the plane flies. For example, if you turn the rudder to the left to make the plane turn, it will keep turning in circles until it hits something.



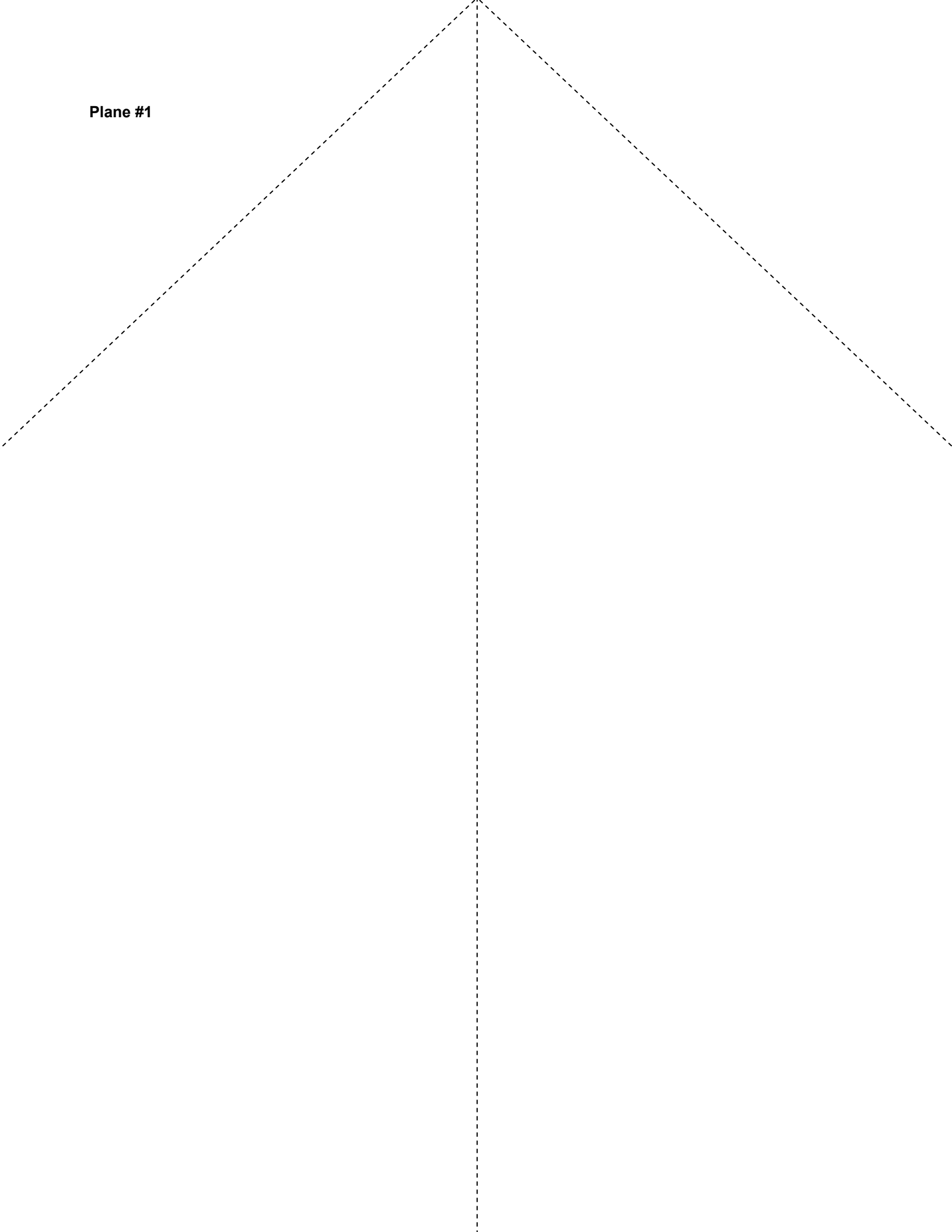

On many paper airplane designs, the **horizontal stabilizer** and the wing are the same thing. In this case, the **elevator** is the trailing edge of the wing. The elevator is the control surface that causes the nose (front) of the plane to go up or down. This is called pitch in aeronautical terms. You can tweak the elevator on your paper airplane to make it pitch up or down. Again, whatever adjustment you make will continue to affect the plane until it hits something. Too much up elevator and you'll do loops. Too much down elevator and you'll fly right into the ground.

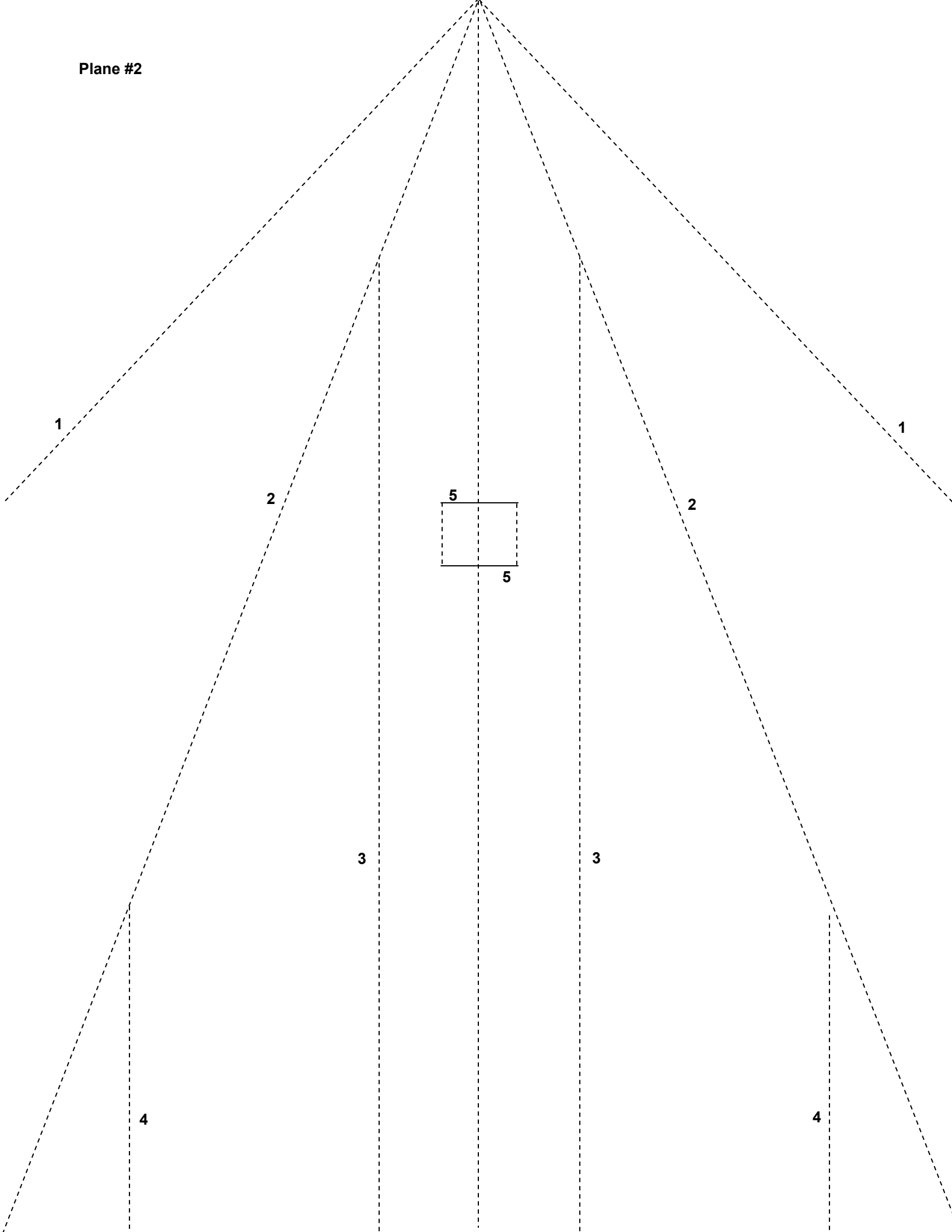
On the following pages, there are four designs for paper ~~airplanes~~ gliders as well as instructions for folding them. Your challenge is to build them, tune them for the best possible flight and then take what you learned from that to make your own design. You may decide what "best" means for you.

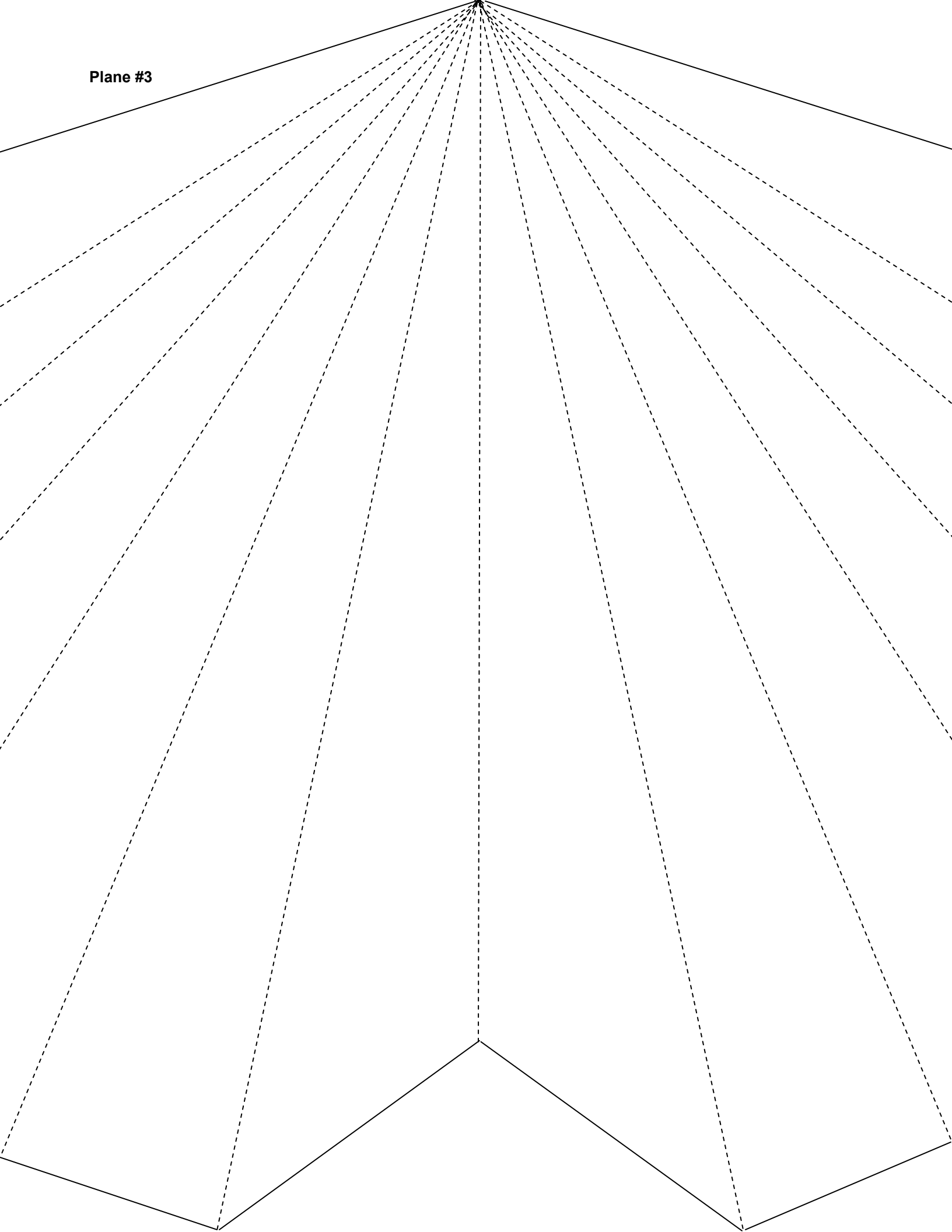
Some suggestions:

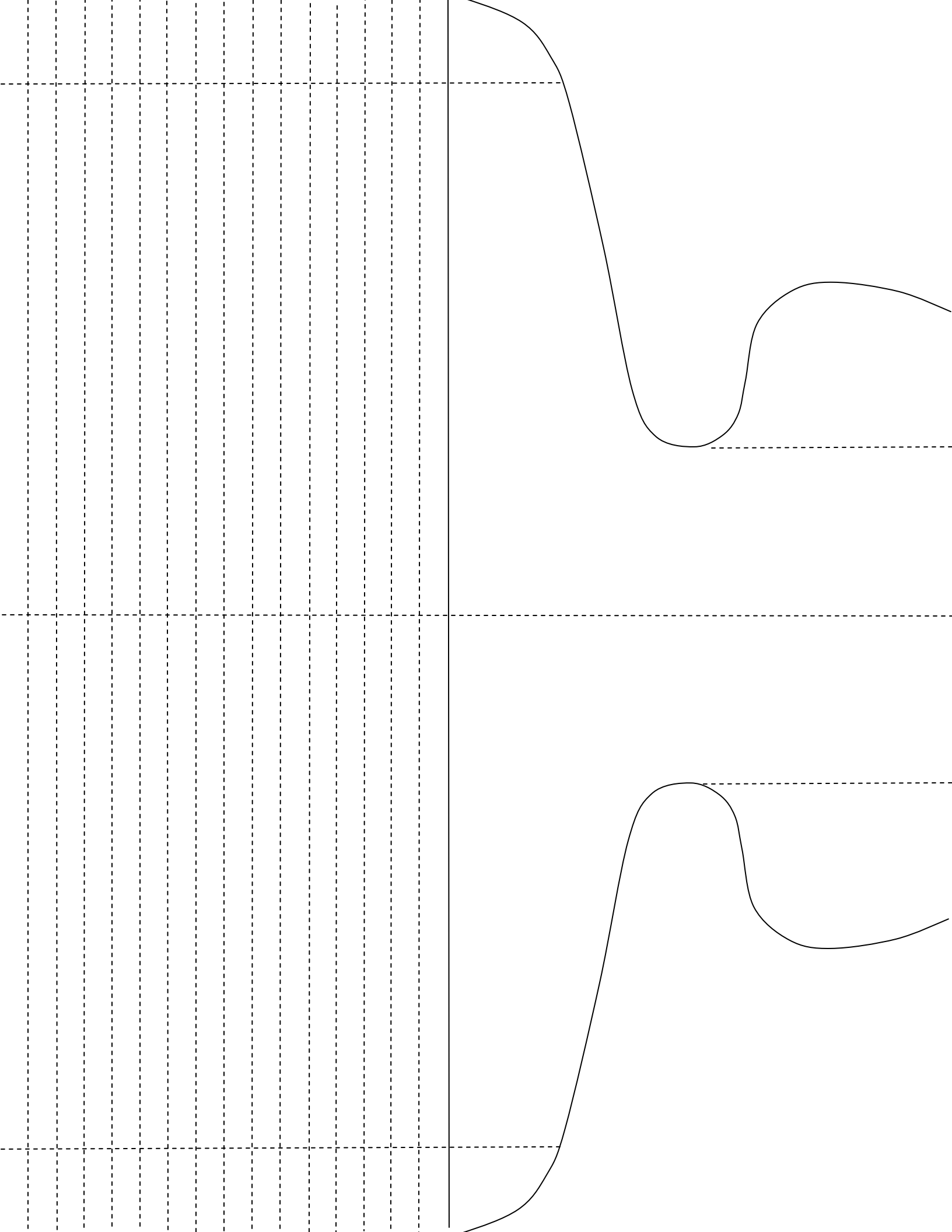
- Make an airplane that stays in the air as long as possible
- Make an airplane that flies as far as possible (distance wise)
- Make an airplane that does backward loops (fairly easy)
- Make a plane that does forward loops (not easy)

**Plane #1**



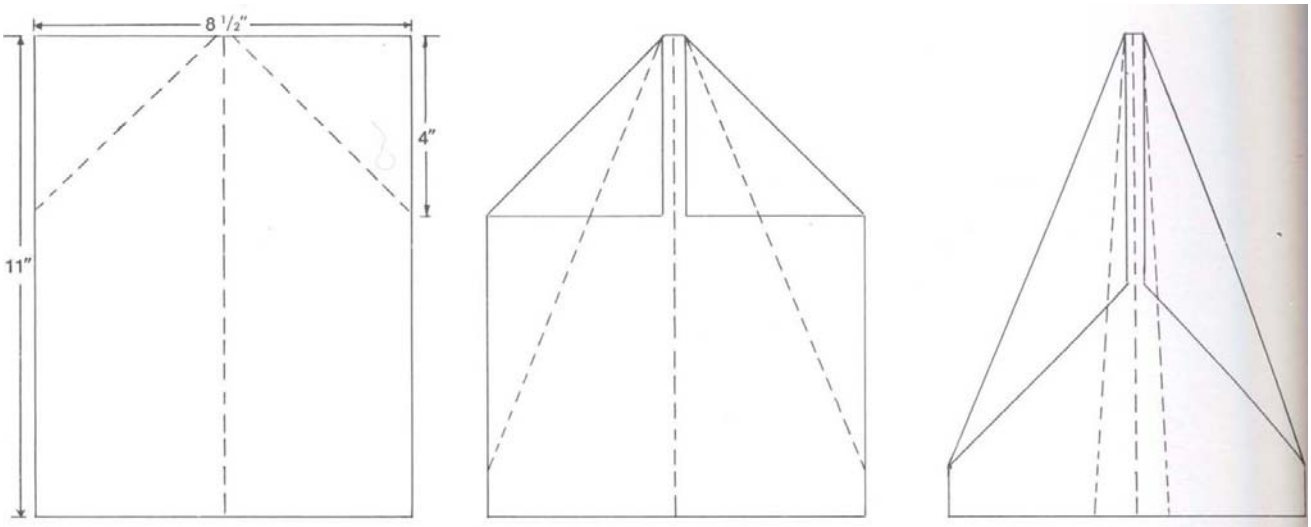

Plane #2
1
2
3
4
5
5
1
2
3
4


Plane #3



# Heads Up Activity – Sample Airplane Designs

**Plane #1**



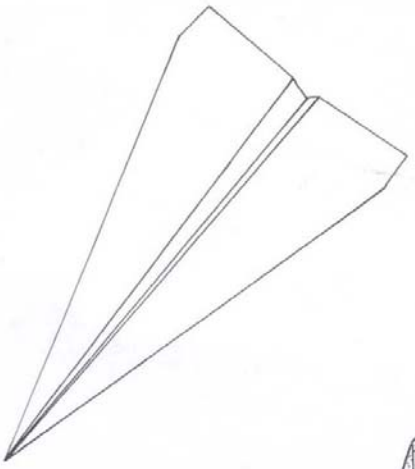

1. Crease on center line.
Fold corners in as shown



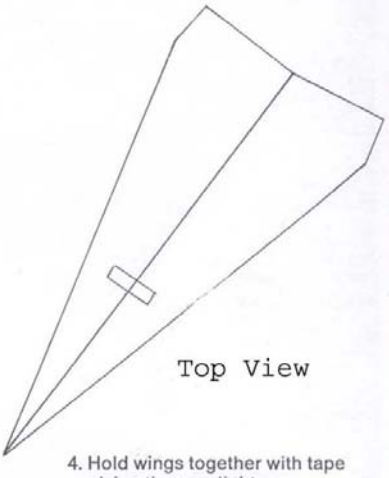
2. Fold again on dotted line



3. Fold away from you
on center line.
Make opposite folds
on dotted lines

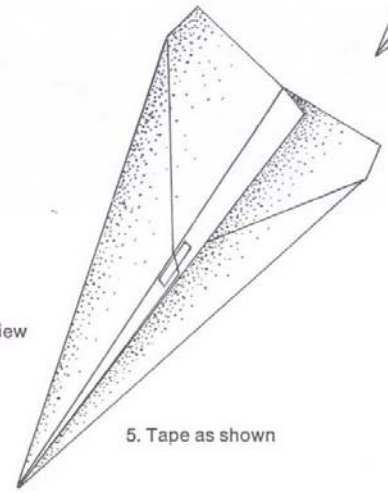


4. To get this



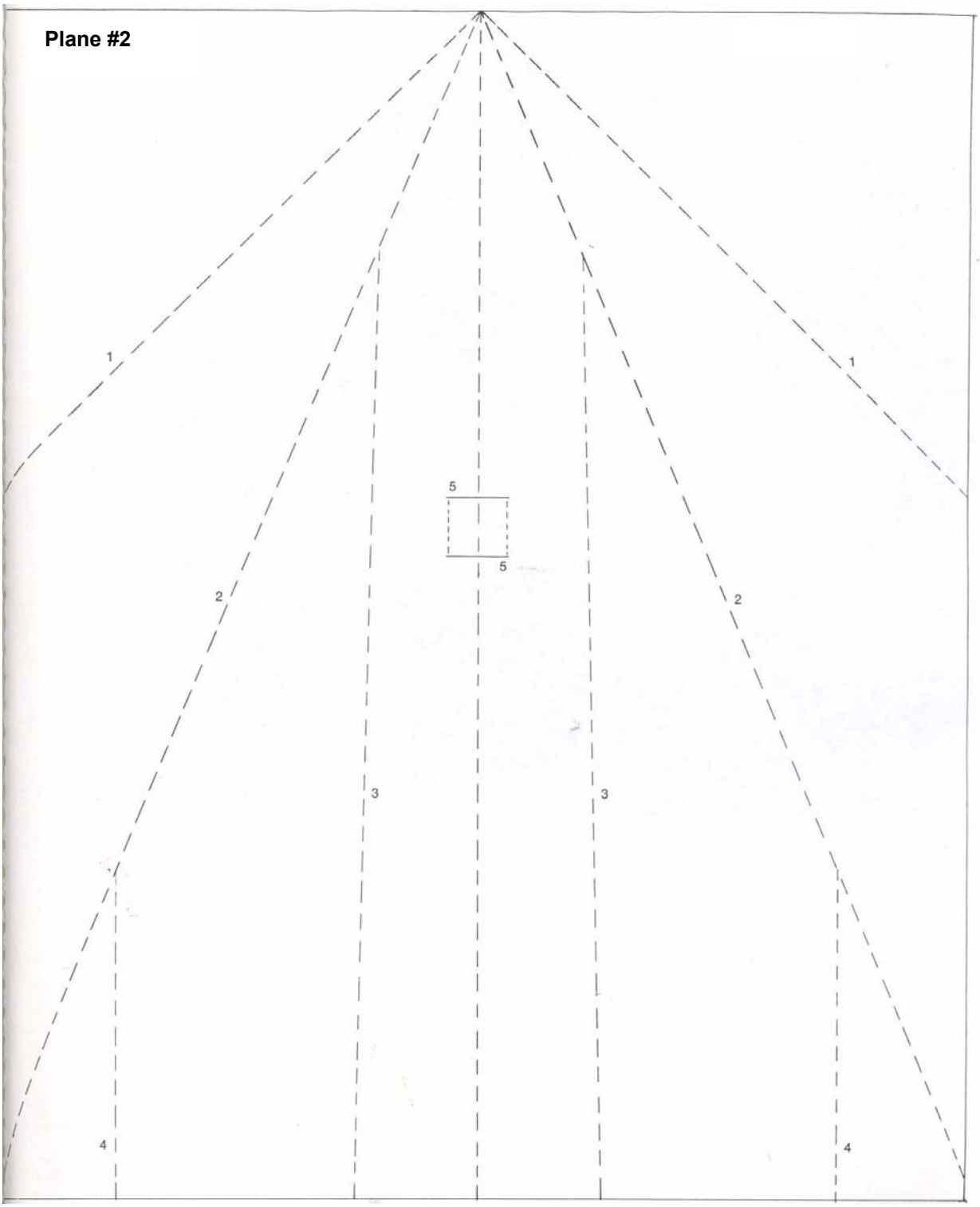
Top View

4. Hold wings together with tape
giving them a slight
upward angle (see photo)



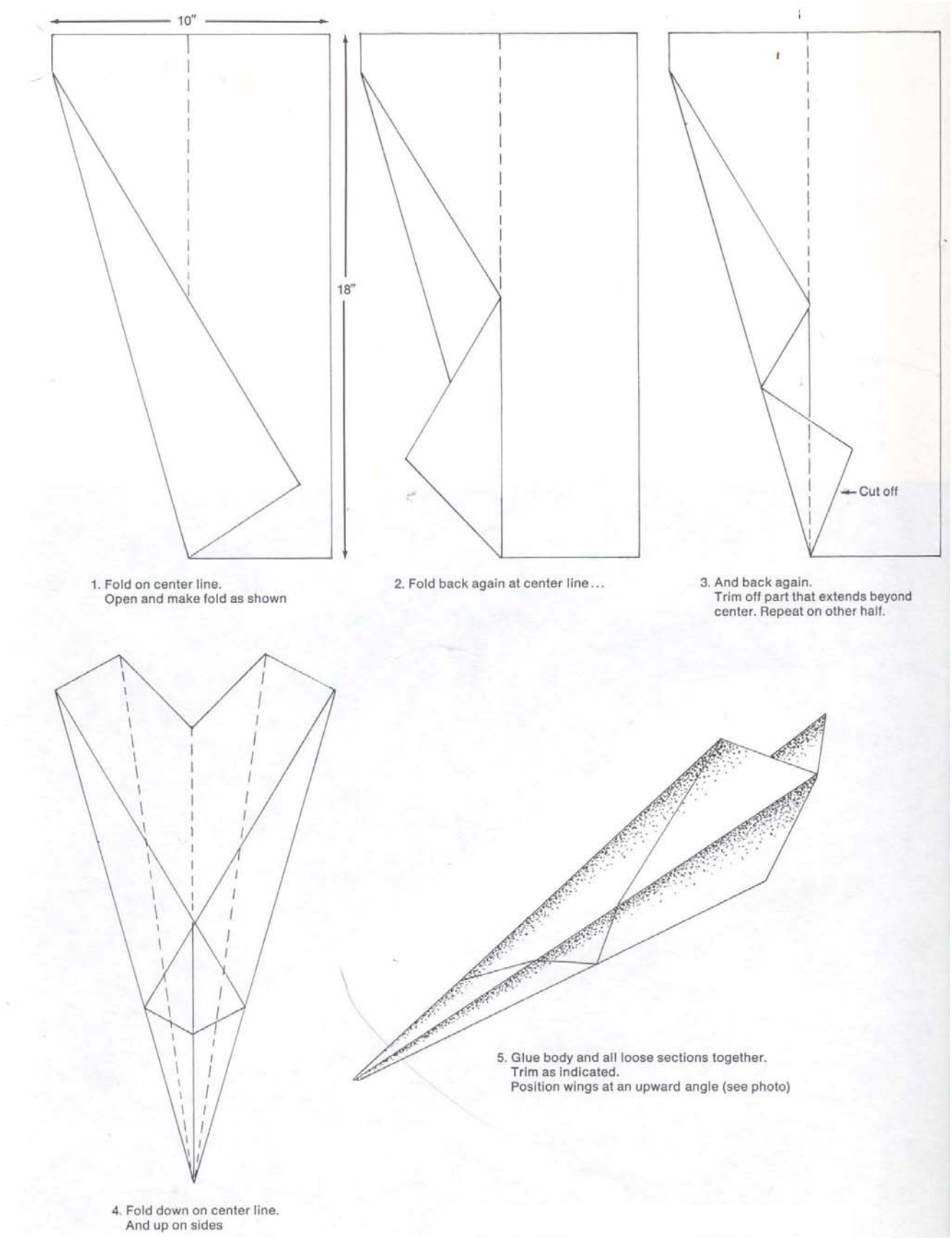
Bottom view

5. Tape as shown

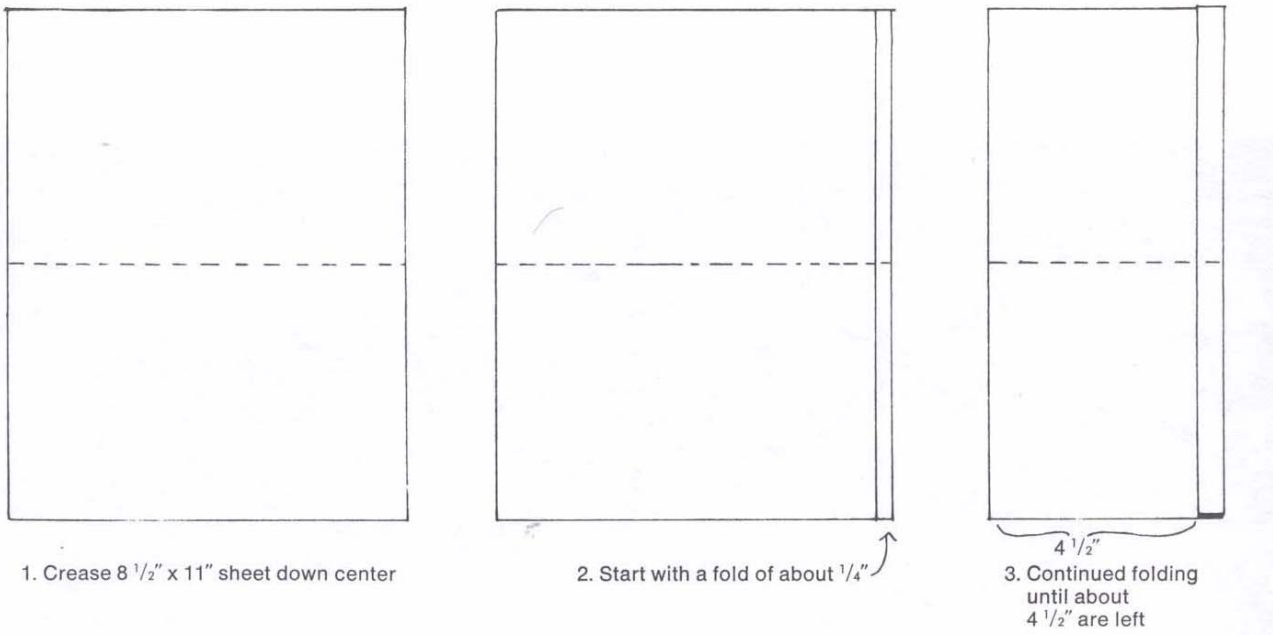


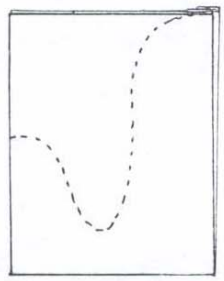

**Instructions for Plane 2**

Fold at the center line. Unfold and fold at 1. Hold down and fold at 2. Fold at center and then fold away from center at 3 to form wing. Form up at 4 to form stabilizer. After folding is completed, cut along solid lines 5. Double up on dotted line to lock body together.

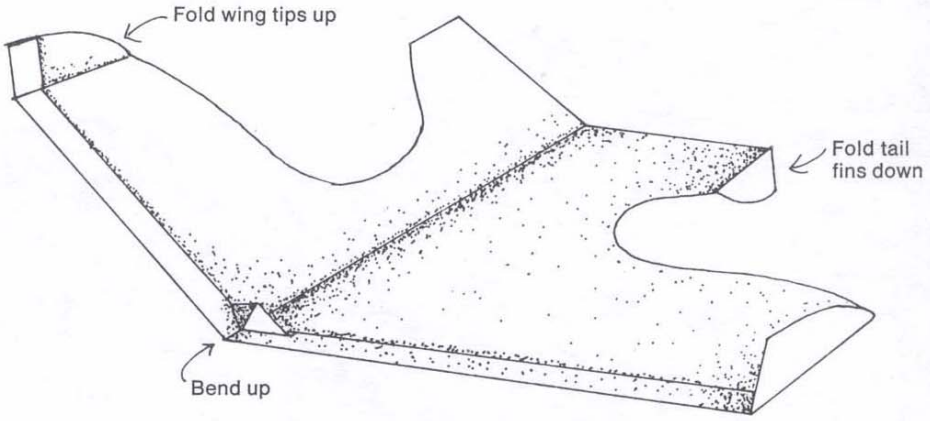



**Airplanes: Lesson 6, Heads Up Activity – Sample Plane Designs**



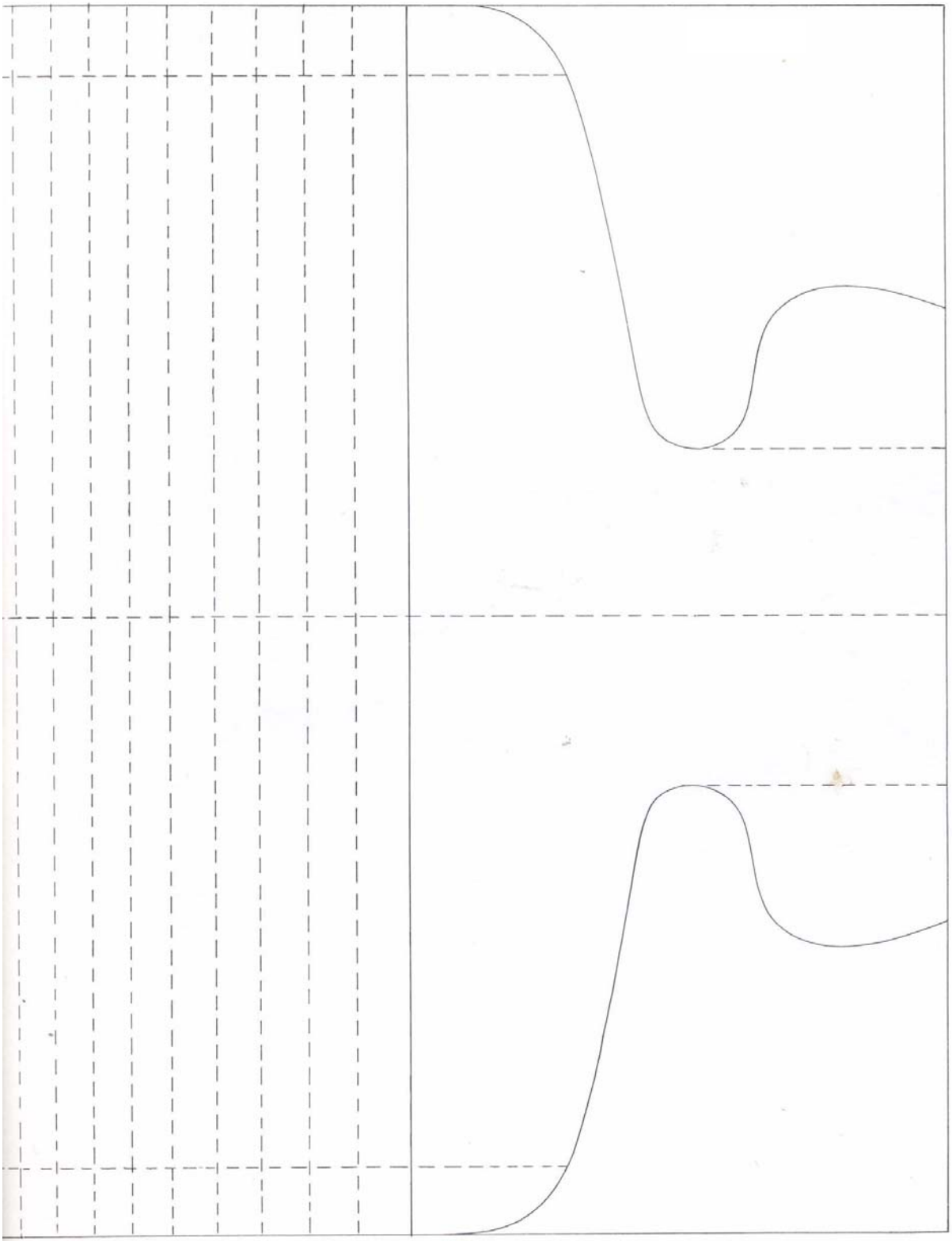



4. Fold in half and cut as shown




**Airplanes: Lesson 6, Heads Up Activity – Sample Plane Designs**

**Plane #4 (continued)**



Plane designs source:

Mander, J., Dippel, G., Gossage, H. The Great International Paper Airplane Book, Simon and Schuster, New York, NY, 1967.