

Glider design-build-fly activity

Summary

This activity provides students with an overview of the concepts involved in designing, building, and flying a small glider. The ultimate objective of this activity is for students to learn and understand the principles of flight through experimentation.

Outline

1. Explanation of airplane components and the principles of flight (10 min)
2. Simultaneous demonstration and construction of small gliders in groups of two or three (30 min)
3. Testing of planes in three challenges: straight, pitching, and rolling flights. (30 min)
4. Brainstorming design iterations and discussion on improving results (10 min)

Activity Time: 80 minutes

Description of the activity

The activity takes place in a space suitable for launching the gliders. This activity time is approximately 80 minutes. A step by step description of the proposed activity is as follows:

1. Explanation of lift and flying (5 min)
2. Description of airplane components and design parameters including the wings, horizontal stabilizer (tail), vertical stabilizer (rudder), and center of gravity (5 min)
3. Simultaneous demonstration and construction of the small gliders. Students in groups of two or three will follow the instructions given by an instructor. Details are in the instructions of page 2 (30 min)
4. Testing of planes in three challenges: straight, rolling, and pitching flights. In straight flight the goal is to validate that the plane flights at trim (level) and for long distances. In rolling and pitching flights the goal is to demonstrate the role of ailerons and elevators in the motion of the glider. (30 min)
5. Discussion on how to improve results (10 min)



Initial version of the glider

Materials for a glider

1. Two sheets of cardstock paper 160-180 g/m²
2. A wooden flattened stick of at least 40 cm long
3. An elastic band
4. Three straws
5. Scotch Magic tape
6. A penny coin
7. A thin board for incline plane
8. Paper cups for incline plane

Instructions for constructing the glider

1. Print the plane templates (located at the end of the document) on two pages of cardstock paper. The printer should be configured to handle paper of weight 160-180 g/m².
2. Cut the frames along the dashed lines of the paper templates. See Figure 2

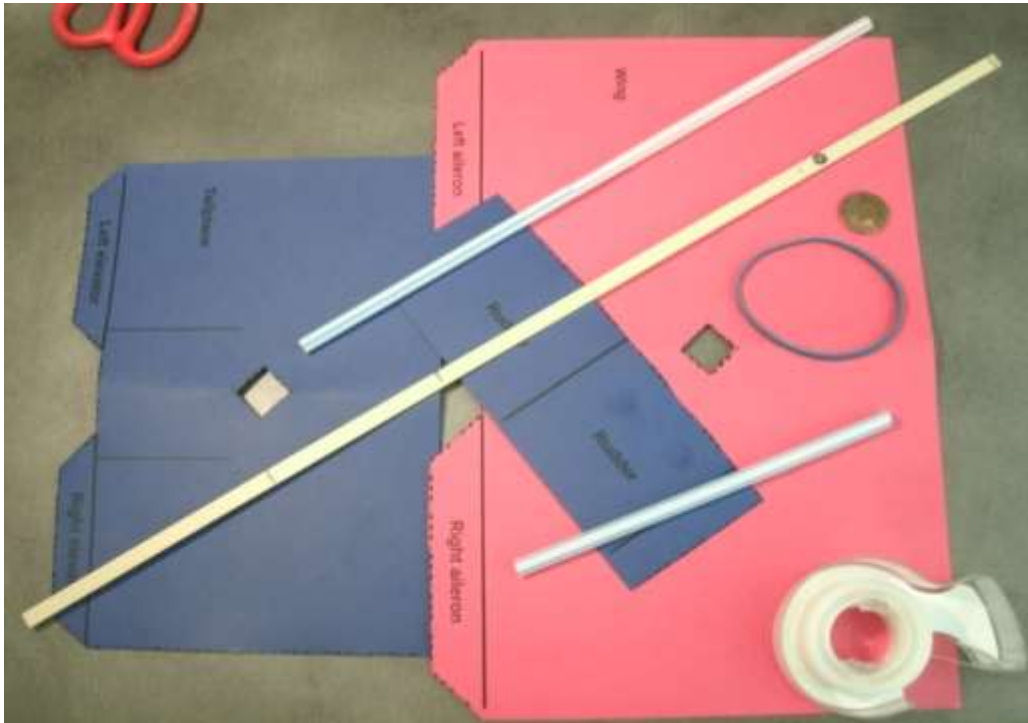


Figure 2.

3. Connect two of the straws.
4. Mark the wooden stick with the locations of the wing, tailplane, and coin. The distance from the rear (trailing) edge of the tailplane and the rear edge of the

wing should be 13.3 cm approximately. The distance from the rear edge of the wing and the coin should be 16.7 cm approximately.

5. Attach the wooden stick, the two-straws rod, and the other straw to the paper frames by using the tape. See Figure 3.



Figure 3.

6. Use the tape to seal the wings and tail as shown in Figure 4.

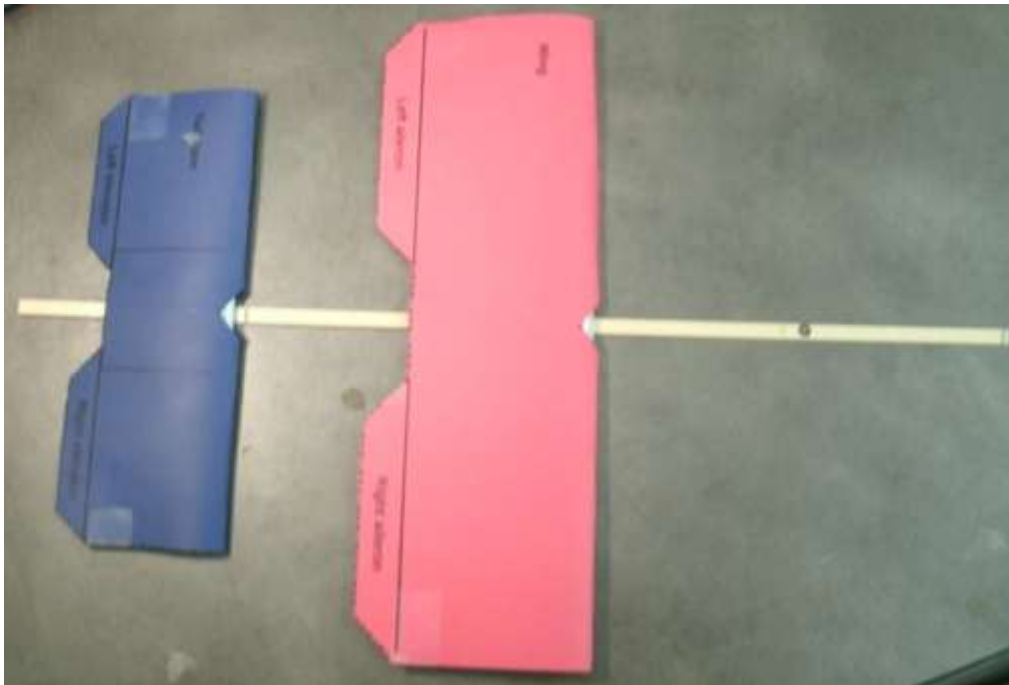


Figure 4

7. Attach the rudder as indicated in Figure 5.



Figure 5.

8. Put a penny coin at the tip of the plane as shown in Figure 6.

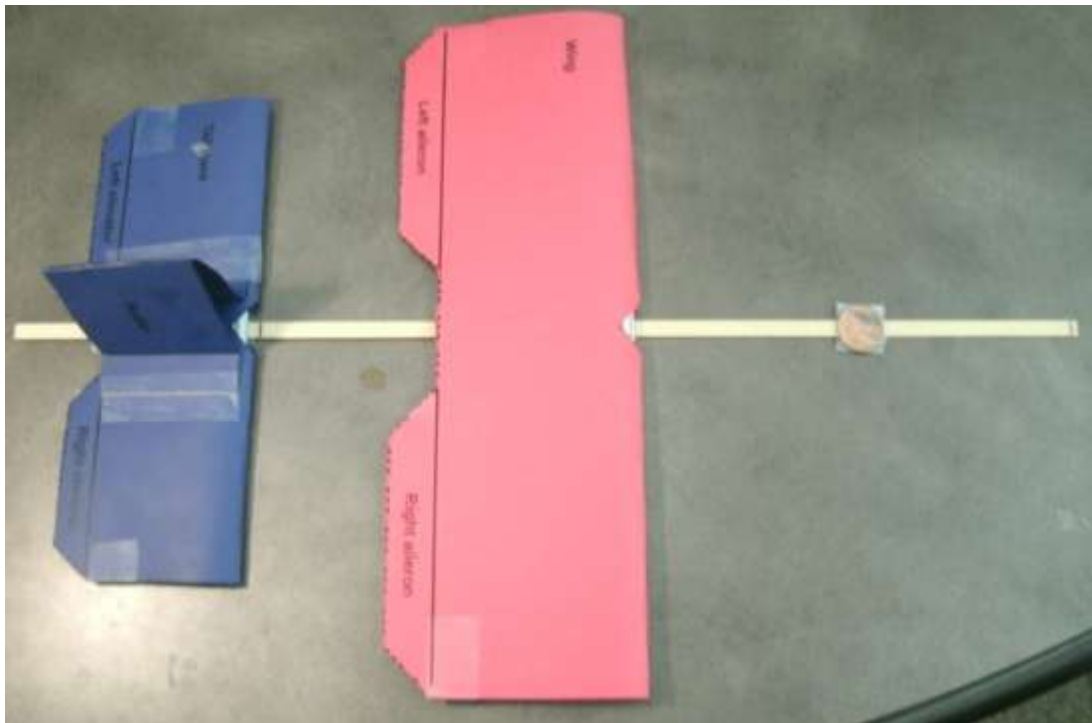


Figure 6.

9. Attach the braided elastic behind the coin as shown in Figure 7.

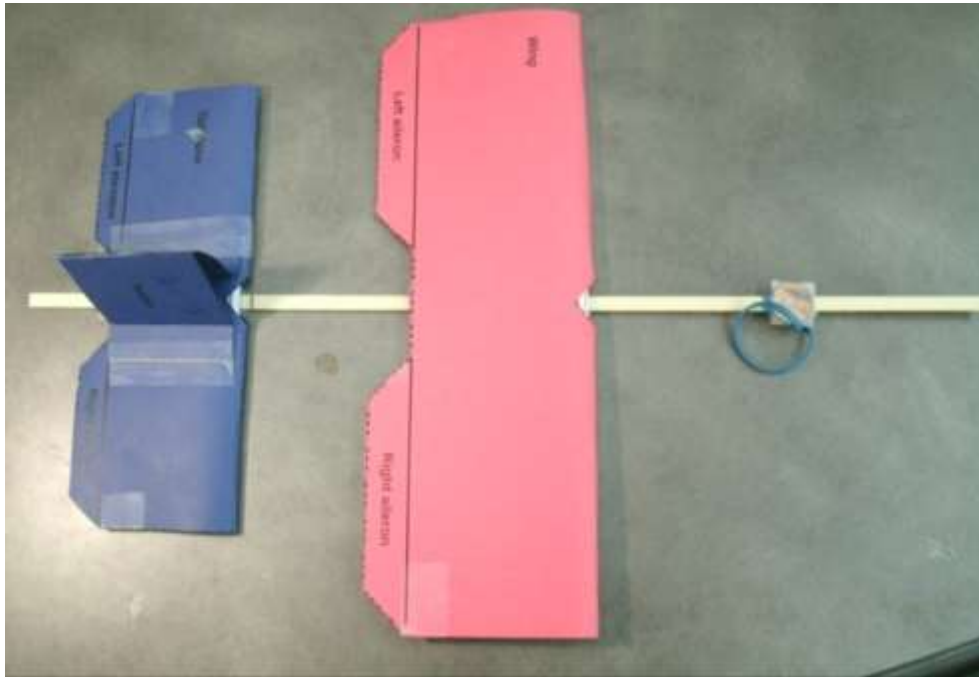


Figure 7.

10. Construct an incline plane as illustrated in Figure 8. A pen/rod should be attached at the foremost side of the board. Then the board should be placed on a paper cup. To fix the incline plane to the table use tape at the backmost side of the board.

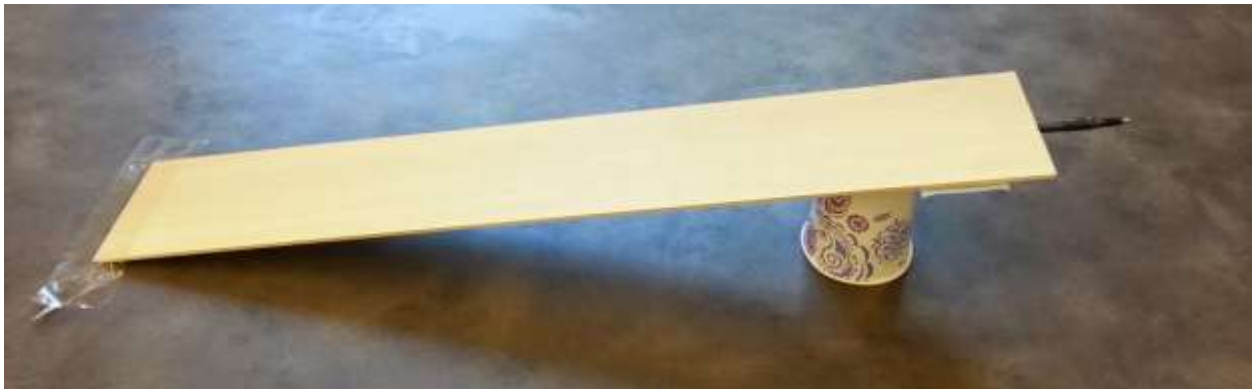


Figure 8

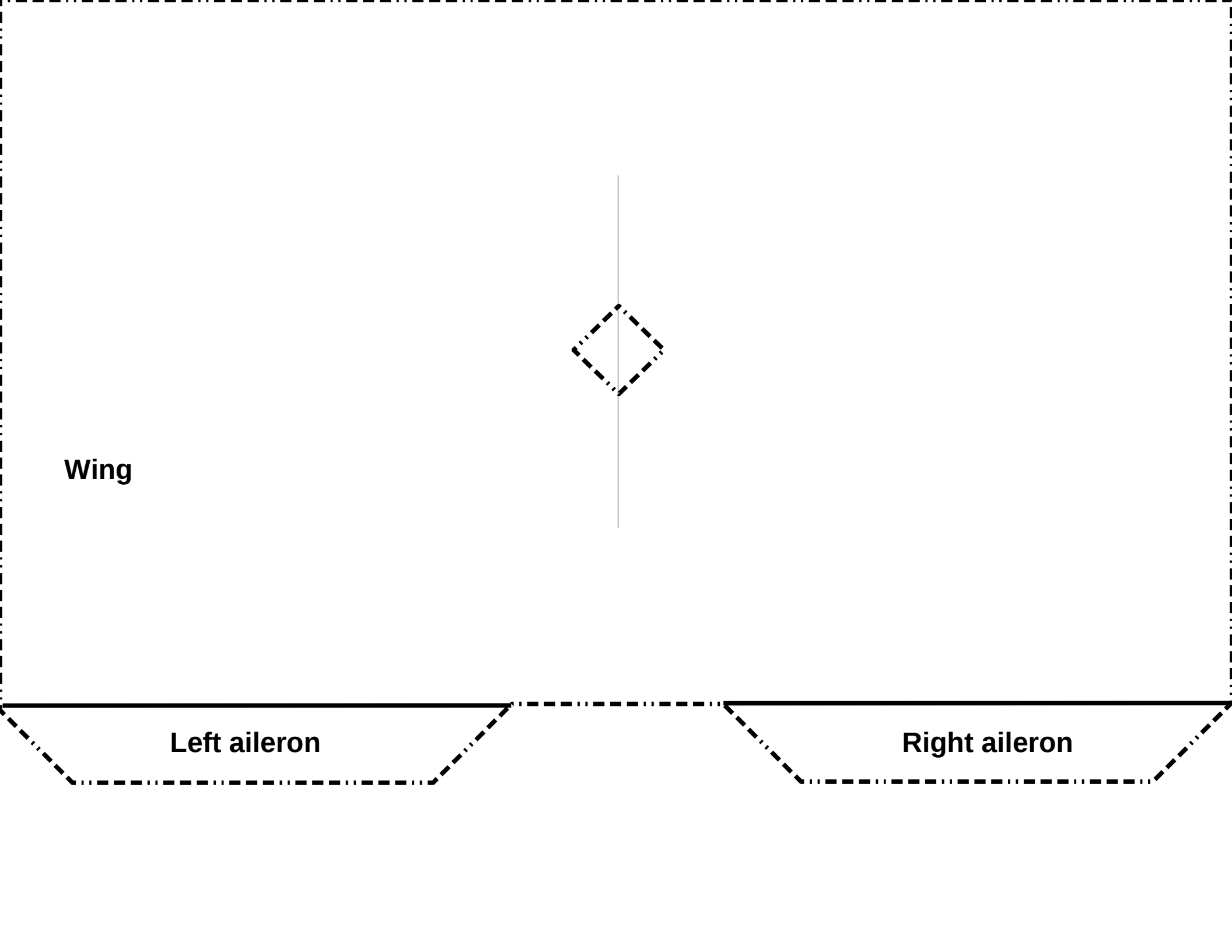
11. Launch the plane using the elastic band. The pen should be used to hold the elastic band.

Activity

Our proposed activity consists of two main sections. First, the kids launch the planes to validate proper gliding. And second, the kids fill out a table (located at the end of this document) of inputs and outputs related to the logic of flight. The different output frames of the second page should be cut. The first page is the table to be filled with inputs during the activity. Detailed instructions are as follows.

1. Form groups of two or three students
2. Launch the plane and check if it glides. Fix the plane if needed.
3. Logic of flight
 - a. Bend (deflect) the left aileron down and the right aileron up and launch the glider. What do you observe? Match the corresponding output with the input on the table.
 - b. Bend the right aileron down and the left aileron up and launch the glider. What do you observe? Match the corresponding output with the input on the table.
 - c. Bend both elevators up and launch the glider. What do you observe? Match the corresponding output with the input on the table.

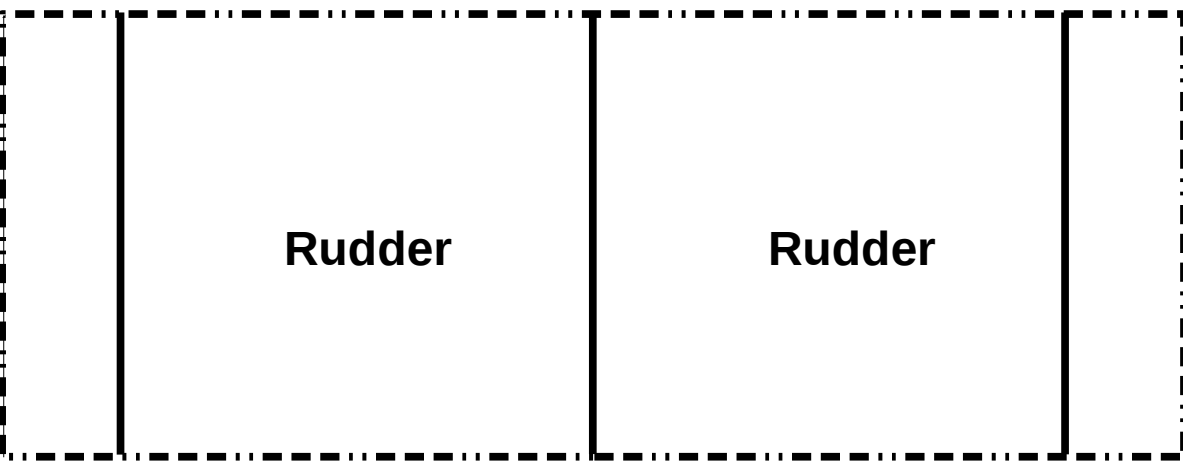
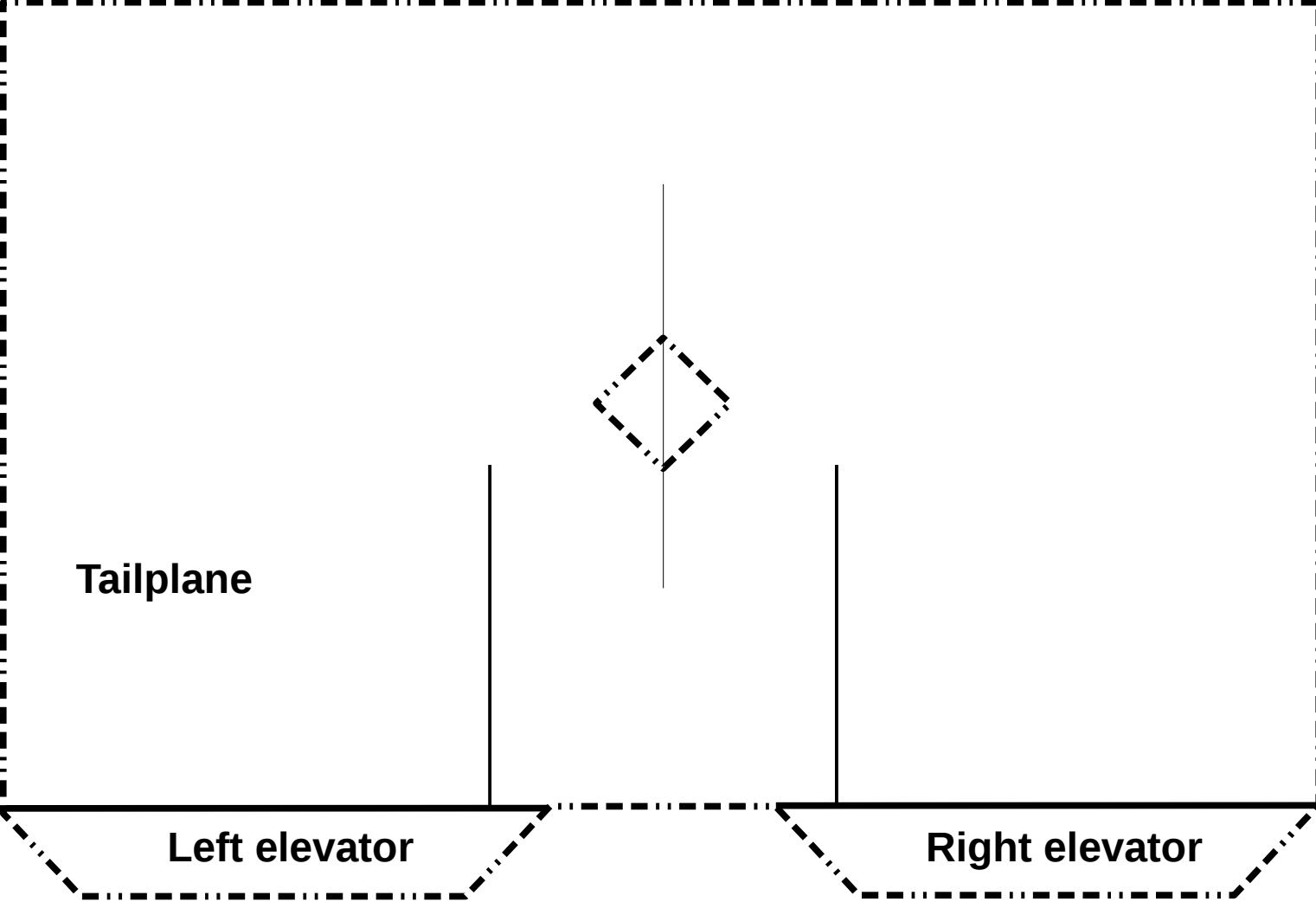
The logic you and the kids discovered is used by human pilots and computer autopilots to drive the motion of aircraft!



Wing

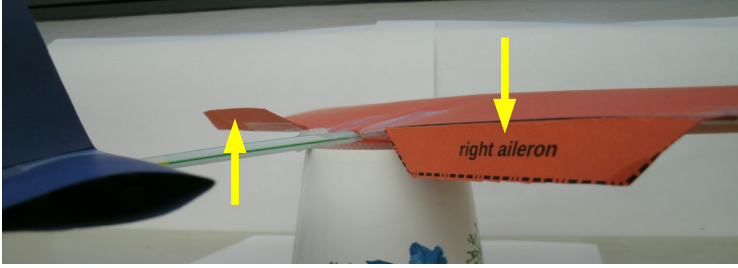
Left aileron

Right aileron



Input

Bend left aileron up and right aileron down



Bend left aileron down and right aileron up



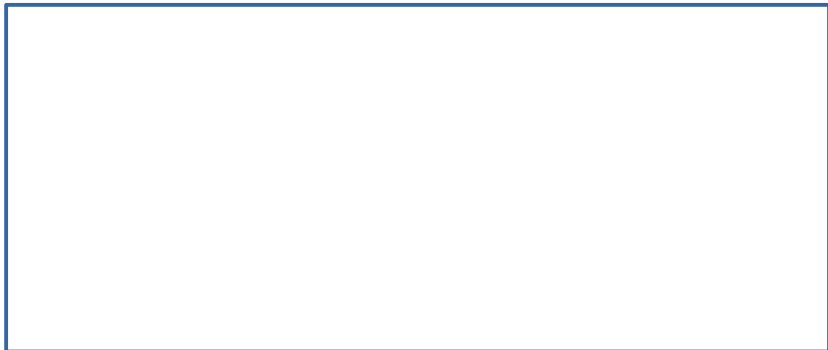
Bend left and right elevators up



Bend left and right elevators down



Output



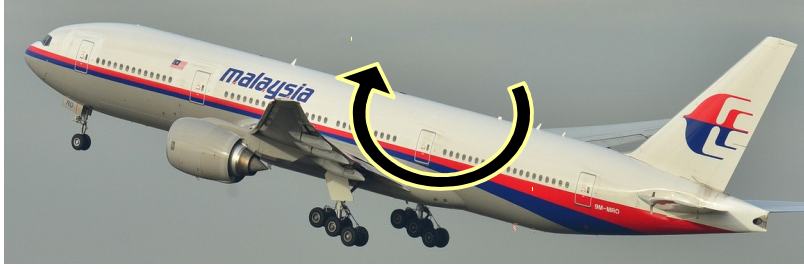
Roll counterclockwise direction



Roll clockwise direction



Pitch up



Pitch down

