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## Teacher Procedure

# Objective

Students test a glider, collect flight data, and design an new glider.

# Procedure

Students will begin this activity by drawing their glider from the top down and determining the aspect ratios. After the ratios are determined, students will throw their gliders three times, take an average, and determine if there is a correlation between aspect ratios and flight distance.

1 Be sure students measure everything to the nearest 10th of a centimeter. The measurements should provide enough information for anyone viewing the drawing to know all the glider's measurements. Do not give the following ratios to the students until they have calculated and tested their own planes. In the discussion that follows, you should find that the planes that went the farthest had the following aspect ratios.

a. The wing of a glider should have an aspect ratio of 6:1. In other words, the length of the wing should be 6 times longer than the chord, or width, of the wing.
b. The length of the fuselage should be 4 to 6 times as long as the chord, or width, of the wing.
c. The distance from the nose of the plane to the front of the wing should be 1 to 1-1/2 times the chord length.
d. The distance from the back of the wing to the front of the stabilizers should be 2 or 3 times the chord length.
e. The area of the horizontal stabilizer should be 20 percent, or 1/5, of the area of the wing.
f. The area of the vertical stabilizer should be about 10 percent, or 1/10, the area of the wing.

2 This is also a good time to talk about the aspect ratios given in Step 1. Be sure students include all dimensions.

# Balsa Glider Test Pilot



## Vocabulary

- aspect ratio
- chord
- fuselage
- horizontal stabilizer
- vertical stabilizer

## Materials

- Completed balsa glider from Activity 7
- Tape measure (to measure distance thrown)
- Ruler (for drawing the glider)
- Graph paper
- Pencil
- "Balsa Gliders Aspect Ratio Data Sheet"

## Procedure

1 Draw your glider to scale from the top down (as seen from above) on the 11" x 17" graph paper.

2 Record all measurements on the "Balsa Gliders Aspect Ratio Data Sheet," and perform all calculations required on the data sheet.

3 Throw your glider three times and record the distance traveled.

4 Take an average of the three throws and record this on your data sheet.

5 Next, move the wing up or down the fuselage approximately 6 cm and record the new measurements and aspect ratio on your data sheets.

6 Throw your glider three more times and record the distance traveled.

7 Take an average of the three throws and record this on your sheet.

8 Did the plane fly better or worse after the wing was moved?

9 Based on your findings of what aspect ratios flew the best, design and sketch a new glider to scale that has a 2-, 3-, or 4-meter wingspan.

# Balsa Gliders Aspect Ratio Data Sheet

Record all measurements to the nearest 10th of a centimeter.

| Glider part | Width (chord) | Length | Aspect ratio | Area (cm²) |
|---|---|---|---|---|
| Wing | | | | |
| Vertical stabilizer | | | | |
| Horizontal stabilizer | | | | |
| Fuselage | | | | |
| Nose to front of plane | | | | |
| Back of wing to stabilizer | | | | |

Ratio of the vertical stabilizer area to wing area _____
Ratio of the horizontal stabilizer area to wing area _____
Ratio of the fuselage length to wing chord _____

Throw your glider three times and record the distance. Be sure you mark your wing placement on the fuselage with a pencil in case a crash landing moves the wing. Calculate and record the average distance flown before and after moving the wing.

Airplane Name:

| Flight # | Distance flown (meters) before moving wing | Distance flown (meters) after moving wing |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | | |
| Average: | | |

## Balsa Gliders Aspect Ratio Data Sheet continued

Move the wing up or down the fuselage about 6 cm and record the new measurements and aspect ratio.

| Glider part | Width (chord) | Length | Aspect ratio | Area ($cm^2$) |
|---|---|---|---|---|
| Wing | | | | |
| Vertical stabilizer | | | | |
| Horizontal stabilizer | | | | |
| Fuselage | | | | |
| Nose to front of plane | | | | |
| Back of wing to stabilizer | | | | |

Ratio of the vertical stabilizer area to wing area _____
Ratio of the horizontal stabilizer area to wing area _____
Ratio of the fuselage length to wing chord_____

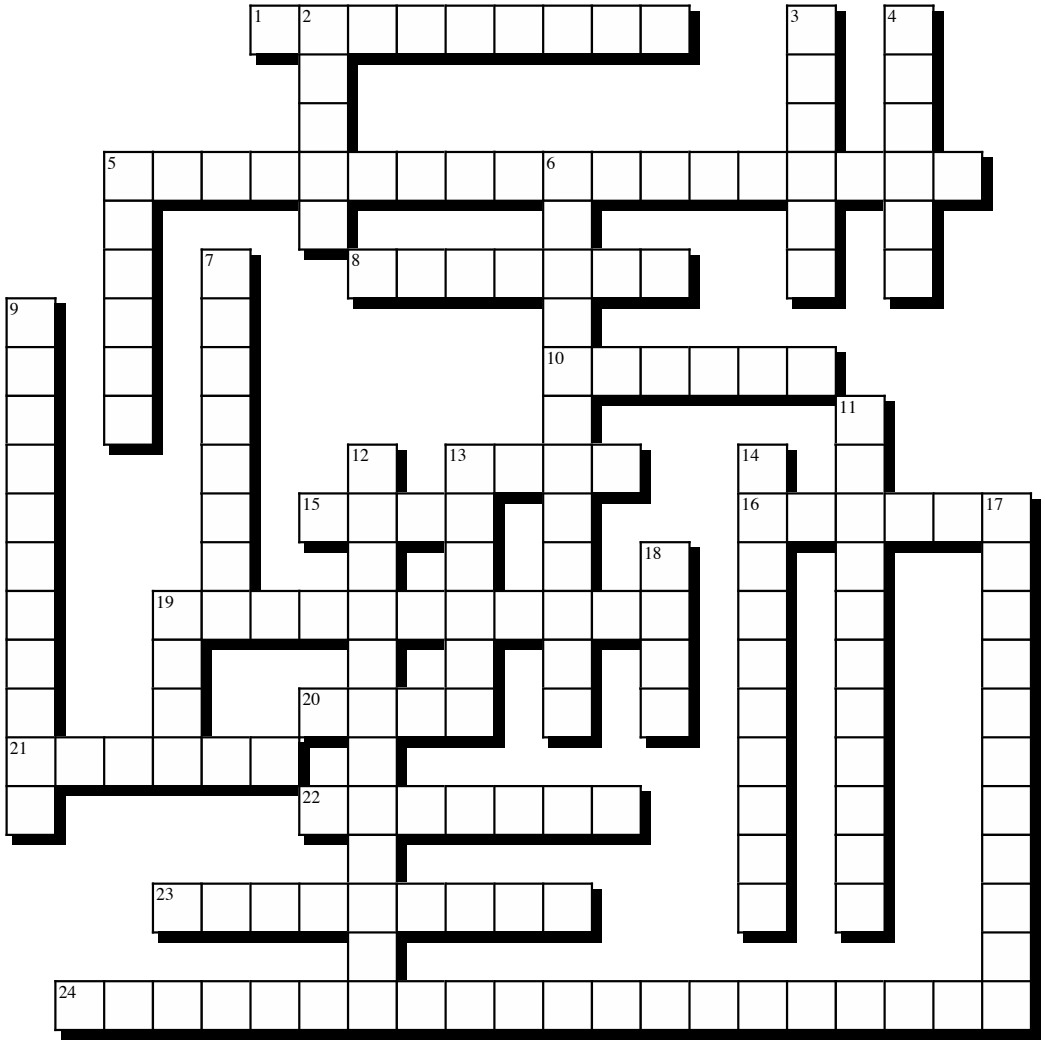
Based on your findings, did the planes fly better or worse after moving the wing?

Typically, in aircraft design, you will find that the planes that went the farthest had the following aspect ratios:

a. The wing of a glider should have an aspect ratio of 6:1. In other words, the length of the wing should be 6 times longer than the chord, or width, of the wing.
b. The length of the fuselage should be 4 to 6 times as long as the chord, or width, of the wing.
c. The distance from the nose of the plane to the front of the wing should be 1 to 1-1/2 times the chord length.
d. The distance from the back of the wing to the front of the stabilizers should be 2 or 3 times the chord length.
e. The area of the horizontal stabilizer should be 20 percent, or 1/5, of the area of the wing.
f. The area of the vertical stabilizer should be about 10 percent, or 1/10, the area of the wing.

Design and sketch a new glider to scale that has a 2-, 3-, or 4-meter wingspan. Be sure to include all dimensions.

# Aeronautical Engineering Crossword II



ACROSS

1 the spinning blades typically at the nose of an airplane that provide thrust to propel the airplane forward
5 a vertically oriented airfoil at the back of an airplane that resists left and right movements
8 to fill an object with air or gas so as to make it swell
10 to set or thrust in motion
13 the major horizontal surface on an airplane that provides lift
15 the forward-most portion of a plane
16 the force that pushes an aircraft forward
19 the front, usually rounded, edge of an airplane wing or airfoil
20 the act or process of rising to a higher position
21 an airfoil mounted vertically toward the rear of an airplane that controls left and right movements
23 the resistance of an airplane to change from its normal course of flight
24 an airfoil (usually at the back of an airplane) that resists up and down changes in motion

DOWN

2 the relationship between quantity, amount, or size between two or more thing
3 the distance from the center of a circle or sphere to the edge of the circle or sphere
4 a geometric shape composed of all points of an equal distance from a center point
5 the amount of space occupied by a three-dimensional object and bottom surfaces come gradually to a point
6 the back edge of an airplane wing or airfoil typically where the top and bottom surfaces come gradually to a point
7 a force applied uniformly over a surface
9 the measured heat of an object
11 the extent of a two-dimensional surface enclosed within a boundary
12 a change in design, hypothesis, or prototype
13 the force of gravity pulling downward on an object
14 an airfoil that maintains stability of an aircraft in flight
17 a device for measuring temperature
18 the area of overlap where two balloon gores are attached along their edges
19 the overall force to which a structure is subjected in supporting a weight or mass or in resisting externally applied forces; the amount of weight or mass supported by the lift of an airplane or airplane wing