

情境

千百年來，人類都希望像雀鳥般在天空翱翔，直至百年前，美國人萊特兄弟才完成人類的飛行夢。雖然飛機已發明了超過百年，但年青人對飛機仍然有濃厚的興趣。

設計綱要

設計並製作一模型滑翔機，並與其他同學的滑翔機進行飛行距離賽。

材料提供

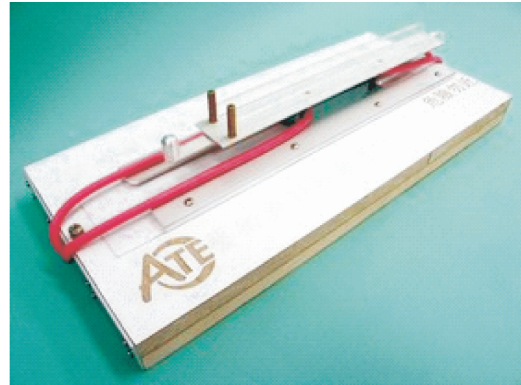
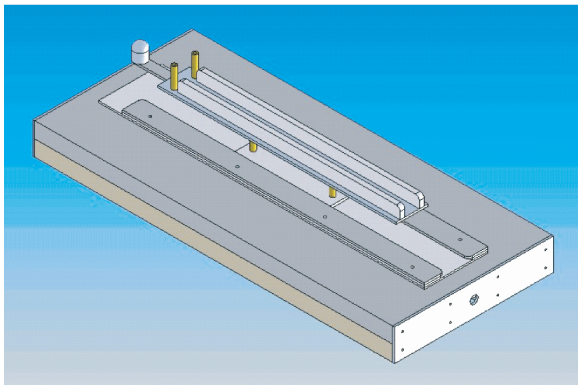
機身及機翼：2x75x 910mm 飛機木一塊。

配件：圓頭螺絲、絲帽和墊圈（機頭配重用）、橡皮圈（機翼暫時定位用）。

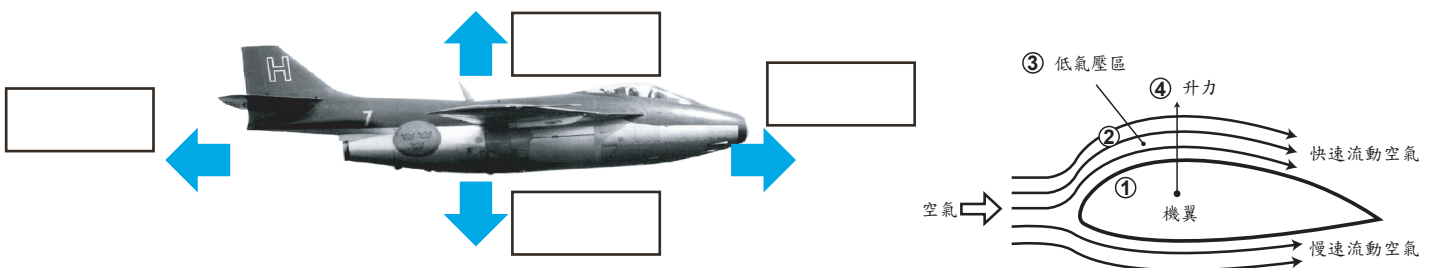
其他合適的材料，（例如：紙 / 高密度發泡膠等）。

比賽規則

1. 所有參賽者必須為在學的初中學生（中一至中三）；
2. 模型滑翔機必須使用指定的發射台(如下圖示)，在一 米高度以水平角度發射；
3. 滑翔機的主翼面積必須不大於28000平方毫米 (sq. mm.) ；
4. 滑翔時間以發射台距離起計，至飛機任何一部份著地為止。

**飛行原理**

飛機必須以升力克服重力，以推力克服空氣阻力才能飛行（如下圖示）。



1. 飛機產生升力是藉著 _____ 截面拱起的形狀。
2. 上方的空氣分子因在同一時間內要走的距離較 _____，所以跑得較下方的空氣分子_____。
3. 造成在機翼上方的氣壓會較下方 _____。如此，下方較高的氣壓，就將飛機支撐著。
4. 產生 _____，浮在空氣中。

這就是所謂的伯努利原理（Bernoulli's Principle）：當流體（水、空氣等的流動速度增加，壓力相對降低。根據伯努利原理，飛機速度愈快，所產生的壓力差（也就是升力）就會愈大。當升力大於重力時，飛機就會向上竄升。

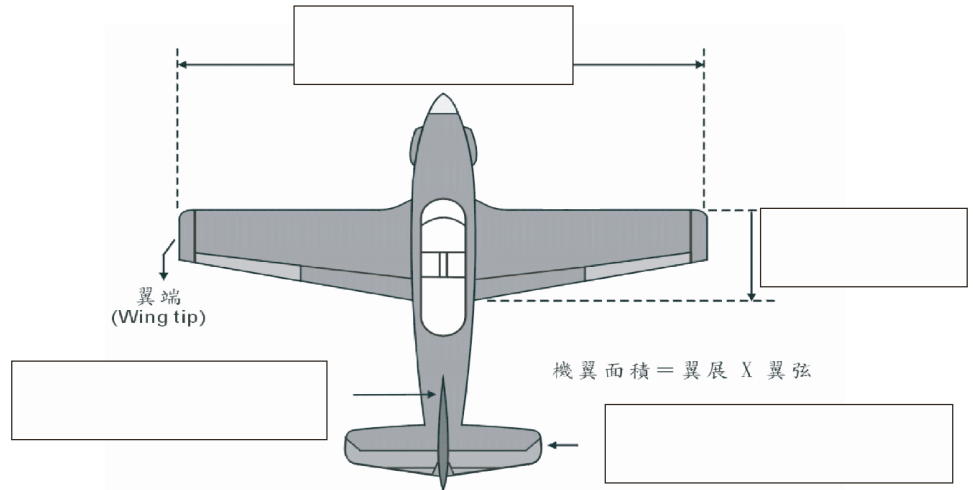
飛機的結構

水平尾翼 - 提供一個矯正滑翔機俯仰或上下搖動的力矩，以確保飛行中的穩定性。

垂直尾翼 - 校正飛行中的偏行或左右迴轉保持方向的穩定。

翼展 - 由一邊的翼端到另一邊翼端的距離。

翼弦 - 由機翼前邊到機翼後邊的距離。

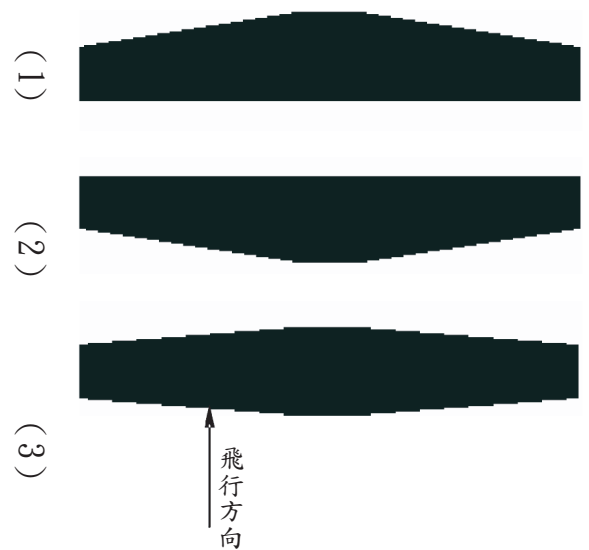


設計機翼

1. 決定機翼的形狀

長方形的機翼會產生較大的阻力，削斜後的機翼減少阻力，改善飛行表現。削斜的角度不可大於10度。

	靈活度	保持直線	穩定性
1	✓		
2		✓	✓
3	✓		✓
你的選擇			

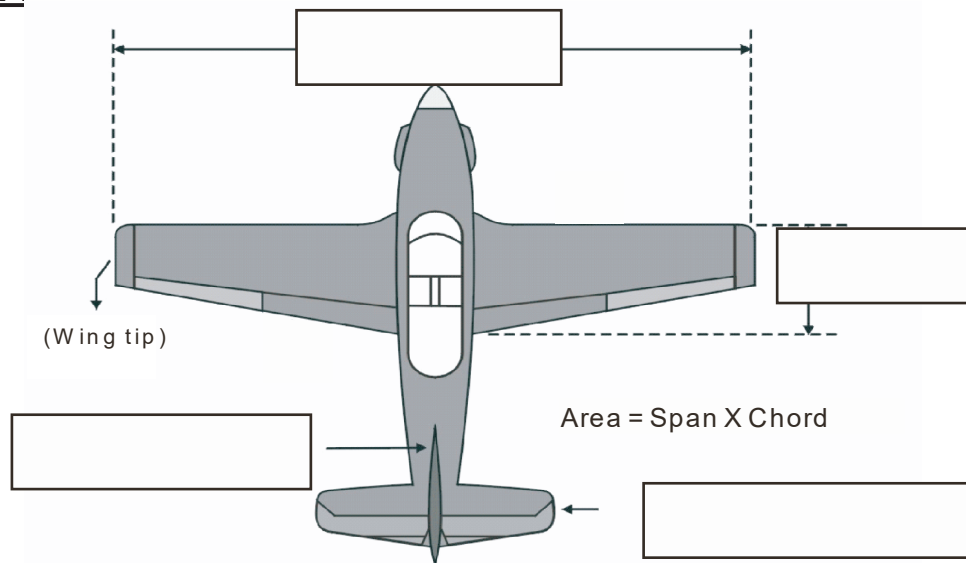


2. 尋求機翼的實際尺寸（翼展與翼弦）

在尋求機翼尺寸前，我們須先確定最大機翼面積（280平方厘米）及翼展及翼弦的比率。有多種的方法去決定機翼的尺寸。以下提供2個計算長方形機翼的例子：

例1：先決定翼弦：翼弦= 4cm	先決定翼弦：翼弦= _____ cm
進行核算，求翼展： 翼展=280sq cm/4cm = 70cm 翼展與翼弦比=70：4	求翼展 =280 sq cm/_____ cm = _____ cm 翼展與翼弦比=_____：_____

Structure of a Flight



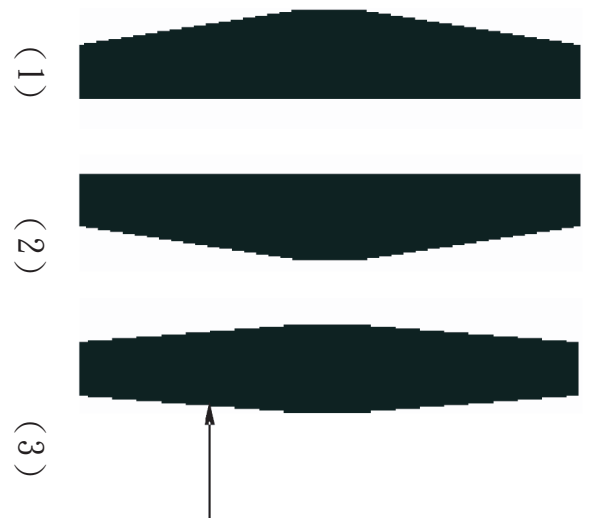
- Horizontal Tail:** Provide stability and torque to modify the wave or shake in flying.
- Vertical Tail:** Modify the shift in flying.
- Span:** Distance between the wing tips.
- Chord:** Distance between the front and back of the wing.

Design the Wing

1. The shape

Rectangular wing produced stouter resistance. Flying performance improved as resistance decrease after slanting the edges. The slanting angle should not larger than 10 degree.

	Flexibility	Keep Straight	Stability
1	✓		
2		✓	✓
3	✓		✓
Your Choice			



2. Accurate Size (Span and Chord)

We should determine the dimensions of the span and chord, and the surface area of the wing. There are many ways to determine the dimensions, here we provide 2 ways for you to calculate the rectangular wing:

Example 1 : Determine the length of the chord. Chord = 4cm	Determine the chord Chord = _____ cm
Calculation: Span = 280 sq cm / 4 cm = 70cm Span : Chord = 70 : 4	The span = 280 sq cm / _____ cm = _____ cm Ratio of span and chord = _____ cm : _____ cm

Situation

Human always eager to fly freely on the sky. About a hundred years ago, the Wright brothers brought this dream come true. Although the plane had been invented over a hundred years, people still interested in investigating the structure of it.

Design Brief

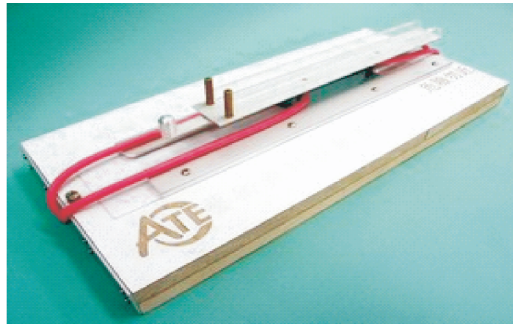
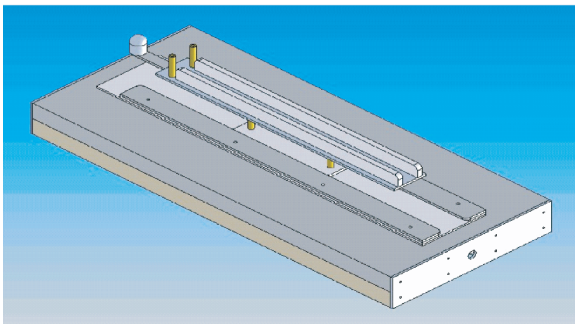
Design and make a model glider which will compete with other students in both gliding distance and time duration.

Supplied Material

- Main body and the wings : Balsa 1 pc 2 x 75 x 910MM
- Parts : Screw / Nut / Washer (loading on the front)
- An elastic band (For fixing the wings on position temporary)
- Other suitable materials (e.g paper / cardboard)

Gliding Competition Regulation

1. Candidate: Junior form student (S1-S3)
2. Glider should launch from the designated launcher which will be fixed on a 1M height stand.
3. Surface area of the glider wings SHOULD NOT larger then 28000 mm square.
4. Distance of gliding will calculating until any part of the glider touch on the runway.

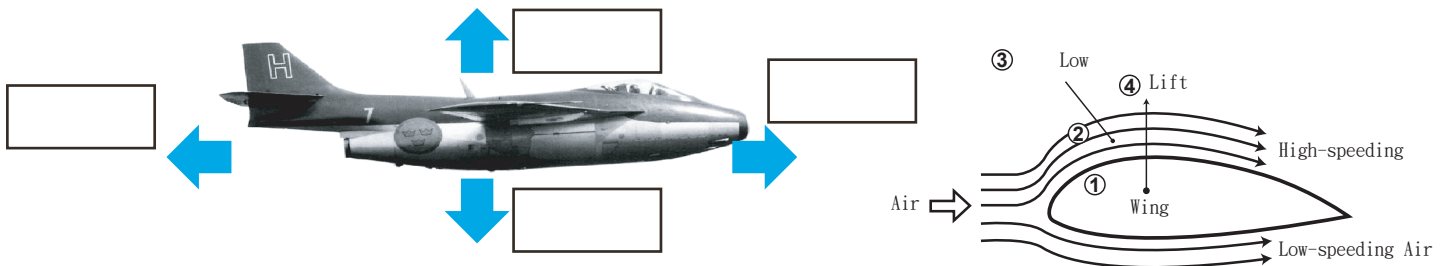


Flying principle

Several forces are particularly important for flight:

While the flight flying, Lift (升力) should larger than Weight(重力), and Thrust(推力) should larger than Drag(阻力).

(As shown below)



1. Lift was produced because the _____ have a curve surface.
2. The molecule of air on the top run _____ because the distance it run is _____ in the same time.
3. The air pressure on the top is _____ than the bottom, therefore the _____ pressure _____ could support the flight.

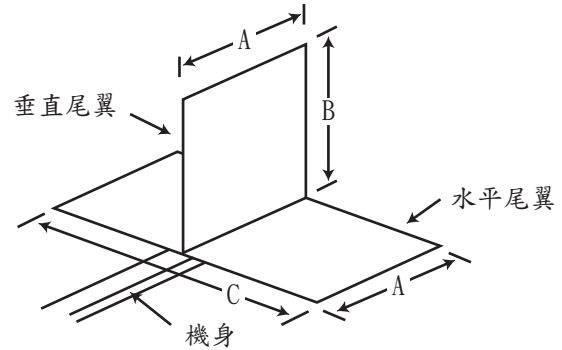
That is Bernoulli' s Principle : When the flowing material (Water/ Air etc.) speed up, the

設計機身及尾翼

機身可用多片飛機木黏合而成，亦可選用10 x2mm的飛機木木條製成。

機身長度的：_____mm，機身寬度：10mm

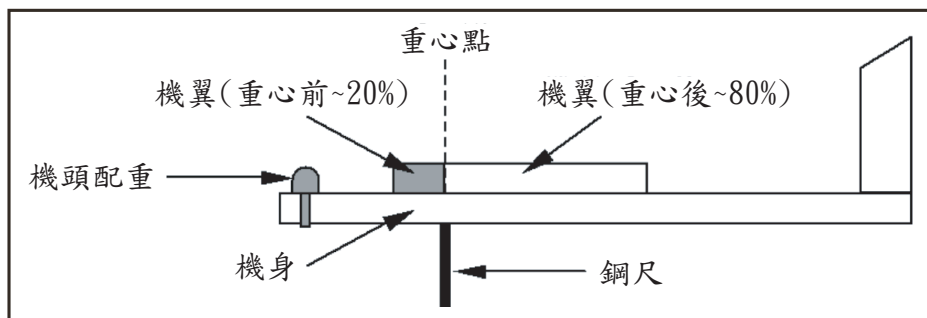
尾翼包括水平和垂直尾翼。垂直和水平尾翼的尺寸可以用以下的程式計算出，注意這只是近似的面積，所使用的實際面積可以大一點或小一點，更可修改成不成同的形狀。



A：_____mm B：_____mm C：_____mm

飛機的重心與平衡

飛機要飛得好首要是有準確的平衡。事實上，如果一架飛機的重心不平衡，就可能會撞毀。



飛行方向的調較	滑翔機重量和機翼位置的調較	
由於結構或物料的影響，滑翔機可能不能直飛。如果滑翔機是單方向彎曲飛行，只須利用適量膠紙貼便可修正滑翔機直線飛行。	發射飛機時，機頭急速下墜：	減少機頭配重或把機翼向前移
	發射飛機時，機頭往上颺：	增加機頭配重或把機翼往後移

課後測驗及檢討

- 飛機木是屬於哪一種木材? 硬木 / 軟木
- 試寫出飛機木的特性? 顏色_____、木質_____、容易_____
- 在測試滑翔機飛行過程中，最近的距離是多少? _____
- 在測試滑翔機飛行過程中，最遠的距離是多少? _____
- 飛機飛行時，機翼哪部份的氣壓較高? 翼面/ 翼底
- 根據伯努利原理，當流體的流動速度增加，壓力相對會怎樣? 增加/ 降低
- 若滑翔機試飛時急速下墜，如何把它修正? 請圈出正確的答案
減少機頭重量 / 增加機頭重量 / 機翼向前移 / 機翼向後移
- 在比賽中，你最遠的距離是多少? _____

評分標準			得分
設計及傳意	繪畫技巧	徒手立體圖 斜視徒手圖 等角徒手圖 投影圖	/40
	設計意念	資料搜集 草繪及繪圖 創意: 形狀、造型	
學生作品	表面處理	安全: 無尖角利邊、成品自身強度適中，不會輕易破爛 工藝: 準確度, 表面處理的質量 正確使用/善用材料 正確使用/善用科技及技術	/50
	功能	功能 外觀: 形狀、造型、顏色、質感、大小比例 工作態度: 包括投入工作、下課時整理工作枱、課堂行為、對工作有要求	
學生態度	行為操守	對社會文化的影響 學生在課堂上的態度	/10
老師評語			總分 /100

Design the Tail

You may combine several pieces of wood or just use a piece of 10 x2mm balsa to make the main body.

Body length : _____ mm

Body width : _____ mm

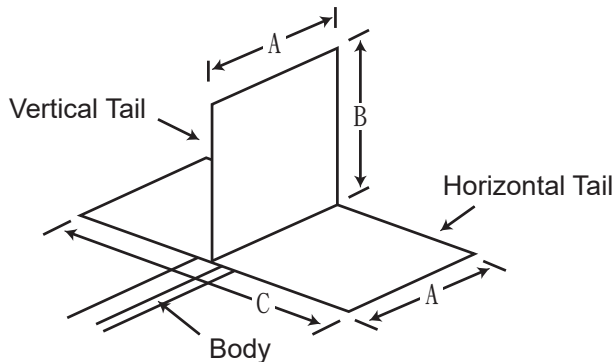
There are 2 parts in the tail: Horizontal and Vertical tail.

Horizontal tail

Horizontal tail is achieved by having a forward center of gravity.

Vertical tail

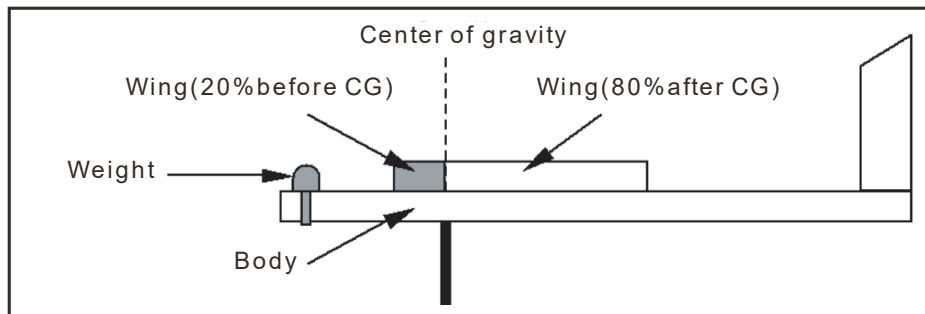
Vertical tail is having more vertical surface area behind the center of gravity rather than ahead of it. This process is called the keel effect.



A : _____ mm B : _____ mm C : _____ mm

Center of gravity and Balance

The accurate balance can help glider fly well. In fact, if the center of gravity of an aircraft imbalance, it may crash.



Adjust the direction	Adjust weight and position of the wing	
Sometime, the glider might not fly straightly which caused by the flight construction or used material. If the glider is just flying in a simple curving path, what you should do is only use a piece of tape to adjust the path.	Glider drop quickly	Reduce the weight at the front
	Unstable flying	Increase weight at the front or adjust the wing position

Review & Evaluation

1. What kind of wood is Balsa? Soft Wood / Hard Wood
2. Try to write down the characteristics of Balsa?
_____ in colour , Nature of wood _____, easily _____
3. During testing, what is the shortest distance? _____
4. During testing, what is the longest distance? _____
5. When the glider is flying, which part of the wing faces a higher pressure?
Top of the wing / Bottom of the wing
6. According to Bernoulli's Principle, when the flowing material speeds up, what happens to the pressure? Increase / Decrease
7. If the glider drops quickly, what should be done to amend it? Please circle the correct answer:
Reduce loading at the front / Increase the leading at the front /
Move the wing position forward / Move the wing position backward
8. What is the longest distance in the competition?

Teacher Comment			Marks
Design Process	Drawing Technique	Freehand Sketch (3D) Isometric Freehand Sketch First angle projection Drawing	/40
	Design Concept	Data Collection Sketch and Drawing Creativity of Shape and Form	
Production Process	Safety	Safety: No sharp edges and corners, Moderate intensity, no easily broken Crafts: Accuracy, Surface finishing Correct / Good use of materials Correct / Good use of technology and skill	/50
	Function of the product	Function Exterior: Shape, Form, Color, Texture, Scale Work attitude	
Student Attitude	Personality	Impact on society and culture Student attitude in the classroom	/10
Teacher Comment			Total /100