

聖文德天主教小學

St. Bonaventure Catholic Primary school

常識科 General Studies

主題：全方位潛望鏡

Topic : All-direction Periscope



STEM Science, Technology,
Engineering, Mathematics

姓名 Name : _____ () P.5()

學習目標 Learning Objectives

S SCIENCE 科學

~能認識鏡子的特性

~To learn the properties of mirror

~掌握光是直線進行的，以及在「全方位潛望鏡」的應用

~To learn that light travels in a straight line and apply this principle to the "all-direction periscope"

~能從生活中找出運用了光的反射原理的例子

~To find out examples that apply the law of reflection in our everyday life

T TECHNOLOGY 科技

~能選用合適的物料及運用鐳射切割機來製作「全方位潛望鏡」

~To choose suitable materials and make use of a laser cutter to produce the "all-direction periscope"

~能製作一個能觀察比視線高的東西的「全方位潛望鏡」

~To produce an "all-direction periscope" that can see an object above our eye level

~善用公平測試來了解光的反射原理，從而找出鏡子擺放的最佳角度

~To conduct a fair test to understand the principle of reflection, so as to find out the optimal angle to place the internal mirror

E ENGINEERING 工程

~能利用 AutoCAD 繪畫工具來設計及準確地繪畫「全方位潛望鏡」的外型及尺寸比例

~To use AutoCAD to design and accurately draw the outlook of the "all-direction periscope" with sensible dimensions

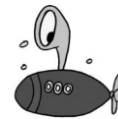
~能透過測試及改良來提升「全方位潛望鏡」的觀察景物效果

~To improve the performance of the "all-round periscope" through tests and modifications

M MATHEMATICS 數學

~懂得量度「角度」，令「全方位潛望鏡」達致最佳的觀察效果

~To measure the angle of the mirror so that it may optimize the performance of the "all-round periscope"



背景資料 - 潛望鏡 Background information - Periscope

潛望鏡是一種利用光線反射原理所製作的光學儀器，構造與普通地上望遠鏡相同，唯另加兩個反射鏡使光經兩次反射而折向眼中。最常被用在潛水艇，用以在水下觀察水面上的動靜。曾在塹壕戰中被用來從壕溝觀察敵軍動態。用潛望鏡來觀看窗外的景物是很有趣的，也可以用它來捉迷藏。另外，科學家也可以利用潛望鏡在地下室中觀察火箭的發射；在進行原子物理實驗的時候，科研工作者利用潛望鏡隔着厚厚的保護牆，就能觀察到那些有放射性的危險實驗。潛水艇在水下航行的時候，也必須利用潛望鏡觀察海面的情況。

A periscope is an optical instrument that applies the principle of reflection. Indeed, it is structurally similar to a telescope. The only difference is that it has two mirrors that reflect light into our eyes. Its most common application is to allow submarine, when submerged at a relatively shallow depth, to search visually for nearby targets and threats on the surface of the water and in the air. It also enables soldiers to see over the tops of trenches. For us, seeing what is outside the window with a periscope is a lot of fun!. How about playing hide-and -seek with a periscope? Even scientists can also use them to observe rocket launching from cellars. During atomic physics experiments, researchers can use them to observe the radioactive processes over the very thick protective walls.



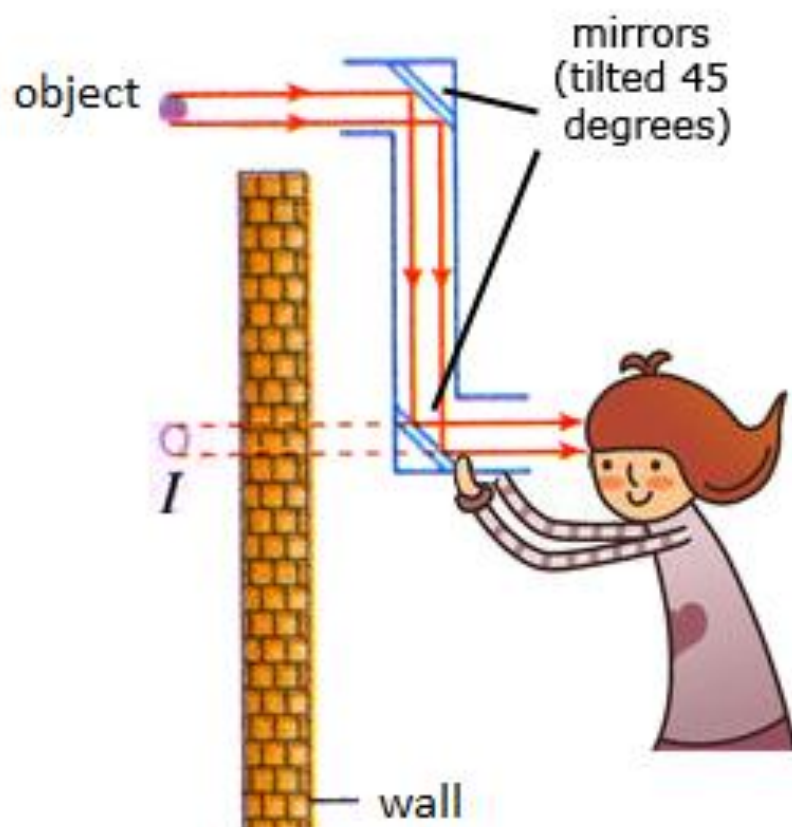
結構原理 The working principle:

潛望鏡通過平面鏡的反射原理，將兩塊平面鏡分別置於潛望鏡兩端的轉角處，兩鏡面平行且相對，利用光沿直線傳播和平面鏡的入射角等於出射角這兩點，這樣人們就可以看到比視線高的東西。

The periscope operates with the law of reflection. It consists of two plane mirrors, each placed at the vertical end of the periscope. The two mirrors are placed such that they are facing and parallel to each other. Making use of the two scientific facts that light travels in a straight line and that the angle of incidence is equal to the angle of reflection when a ray of light reflects from a surface, this structure allows us to see an object above our eye level.

資料來源 Source of information :

<https://www.wikiwand.com/zh-hk/%E6%BD%9B%E6%9C%9B%E9%8F%A1>



探究情景 Situation of the inquiry:

小芳的表姐飼養了一隻小倉鼠，膽小的小芳很想走近牠，看看倉鼠的可愛容貌。但每當走近，她都會感到非常害怕。她想：「怎樣觀看小倉鼠，而不令自己害怕呢？」

Fong's cousin keeps a little hamster. The yellow-bellied Little Fong is eager to get close to it so that she can see its lovely face. However, every time when she is near it, she is scared. She is wondering how she can observe it without making herself so frightened.

這時她突然回想鏡子反射的科學原理，她希望利用鏡子反射的科學原理來設計一個觀望倉鼠的全方位潛望鏡，使自己能在輕鬆的心情下，了解倉鼠的生活情況。究竟這個全方位潛望鏡是如何做？現請同學幫小芳一同設計。

Suddenly, the law of reflection crops up in her mind. " Maybe I can apply mirror reflections to design an all-direction periscope so that I can observe hamsters' living in a relaxed manner." How does she make this instrument? Please help her to design it.



「全方位潛望鏡」的特色：

1. 「觀察景物」的效果出色
2. 配上可愛的動物圖案，使外形更吸引

資料搜集 Information searching

同學可以把從圖書、光碟及互聯網上找到的有關資料，寫出、貼上或繪畫在下面的方格內。（*資料途徑：潛望鏡的外型、鏡子的特性和功用或科學原理）

Students can find information from books, CDs and the Internet, Write, paste or draw in the box below. (*Information: the shape of a periscope, the characteristics and functions of mirrors or the scientific principle, etc)

資料來源 Sources :



你會應用上述哪些資料於設計中？在□中加✓

Which information will you apply in your design? Put a ✓ in the box.

☐ 外形 The shape

☐ 科學原理 The scientific principles

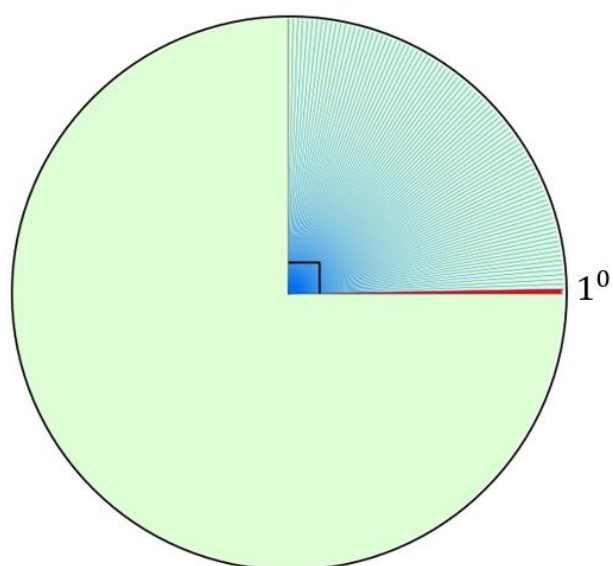
☐ 功用 The functions

☐ 其他 Others : _____

度(角)

度是平面角的單位，符號為「°」。一周角分為 360 等份，每份定義為 1 度（1°）。

Degree is a unit of a plane-angle with 「°」 as its symbol. When a full angle is divided into 360 equal parts, the angle of each part is assigned the numerically value of "1°".



之所以採用 360 這數值，是因為它容易被整除。360 的真因數除了 1 和自己之外，共有 22 個（2、3、4、5、6、8、9、10、12、15、18、20、24、30、36、40、45、60、72、90、120、180），所以很多特殊角的角度都是整數。

Why do mathematicians choose "360 degrees" to assign a full angle? It is because this number is divisible by a vast amount of integers. There are 24 factors for this number (1、2、3、4、5、6、8、9、10、12、15、18、20、24、30、36、40、45、60、72、90、120、180、360). Therefore, many "special angles" are also integers.

在實際應用中，整數的角度已經夠精準。當需要更準確的角度值時，如天文學中量度星體或地球的經度和緯度，除了可用小數表示，還可以把角度細分為角分和角秒：1 度為 60 分（60'），1 分為 60 秒（60''）。例如 $40.1875^\circ = 40^\circ 11' 15''$ 。要再準確一點的話，便用小數表示角秒，不再加設單位，如 0''.36。

In terms of its practical usage, it is already very accurate to use an integer. However, when we need to measure the angle more accurately, like the longitude and latitude of a star or earth in the field of astronomy, we can extend the digits to decimals places. We may also use the minute or second of arc to represent such a sophisticated angle. 1 degree is equal to 60 minutes of arc; and 1 minute of arc is in turn equal to 60 seconds of arc. For example, $40.1875^\circ = 40^\circ 11' 15''$. If you need an even more accurate measurement of an angle, we may extend the decimal places of a second of arc, like 0''.36. Please note that there is no additional unit for the division of a second of arc.

資料來源 Sources : [https://www.wikiwand.com/zh-hk/%E5%BA%A6_\(%E8%A7%92\)](https://www.wikiwand.com/zh-hk/%E5%BA%A6_(%E8%A7%92))

公平測試 Fair Test

探究問題(1): 鏡子的數量如何影響「全方位潛望鏡」反射出的「像」的方向

Inquiry question (1): How is the property of an image affected by the number of mirrors in an all-direction periscope?

1. 目的：了解鏡子的數量與「像」的方向的關係

1. Aim: to understand the relationship between the number of mirrors and the property of an image

2. 假設：我估計用(1 面/2 面) 鏡子，所反射出的「像」的方向會與實物相同

2. Hypothesis: If I use (1 / 2) mirror(s), the image is identical to the object.

3. 測試 Test:

	鏡子數量 Number of mirror	鏡子數量 Number of mirror
	1	2
「像」的方向 Property of an image	相同 / 左右倒轉 Identical / Laterally inverted	相同 / 左右倒轉 Identical / Laterally inverted

4. 總結:要讓「全方位潛望鏡」反射出的「像」的方向與實物相同，鏡子的數量需要()面。

4. Conclusion: To produce an image that is identical to the object, I need () mirror(s).

設計工程

Engineering design

你需要設計一個「全方位潛望鏡」，能觀察到比視線高的東西，而且能清晰而完整地把「像」反射。

Design an "all-direction periscope" such that it can produce a clear and whole image from an object that is above our eye level.

- 將你構思中的「全方位潛望鏡」外型、尺寸比例及物料展示在下面的空格內。
- Draw your "all-direction periscope" and annotate it with sensible dimensions and suitable materials.



「全方位潛望鏡」的特色 Features of your "all-direction periscope"

☐外型設計獨特

The design is unique

☐能觀察到比視線高的東西

You can see an object above eye level

☐組件接合穩固

The components can be firmly assembled

☐能清晰而完整地把「像」反射

It can produce a clear whole image

預計製作「全方位潛望鏡」時出現的困難

Predict any difficulties that you may face when making the "all-direction periscope".

☐外型設計 The outlook of the "all-direction periscope"

☐組件的接合 The assembly of wooden parts

☐AutoCAD 繪畫軟件的應用 How to use AutoCAD software

☐工具運用 The proper use of different tools

● 解決方法 Ways to deal with the difficulties:

製作過程 Production process

步驟 Steps	圖畫 Diagrams
1.	
2.	
3.	
4.	
5.	
6.	

公平測試 Fair Test

探究問題(2):哪個角度的鏡子組合，才能把「像」完整地反射出來？

Inquiry question (2): In what angle should we position our mirror, so that it may produce a clear whole image?

1.目的：了解鏡子的角度與「像」的清晰度的關係

1. Aim: understand the relationship between the angle of the mirror and the clarity of the image

2.假設:我估計用(30° / 45° / 60°) 的鏡子組合，才能把「像」完整地反射出來。

2. Hypothesis: I believe that when the mirror is placed at (30° / 45° / 60°) at the both ends of the periscope, it can produce a clear whole image.

3. 測試 Test: (請把觀察到的結果圈出) Please circle the suitable statement according to your observation.

	鏡子角度 The angle between the mirror and the wall 30°	鏡子角度 The angle between the mirror and the wall 45°	鏡子角度 The angle between the mirror and the wall 60°
「像」的 清晰度	<ul style="list-style-type: none"> • 未能看到「像」 Cannot see the image • 看到部份的「像」 Can see part of the image • 看到完整的「像」 Can see the whole image 	<ul style="list-style-type: none"> • 未能看到「像」 Cannot see the image • 看到部份的「像」 Can see part of the image • 看到完整的「像」 Can see the whole image 	<ul style="list-style-type: none"> • 未能看到「像」 Cannot see the image • 看到部份的「像」 Can see part of the image • 看到完整的「像」 Can see the whole image

4. 總結：要讓「全方位潛望鏡」反射出的「像」完整地反射出來，鏡子組合的角度需要()。

Conclusion: To produce a clear whole image, the angle between the mirror and the wall is ().

「全方位潛望鏡」測試

Test the Periscope

在適當的方格內加上「✓」號

Put a '✓' in the appropriate boxes.

「全方位潛望鏡」裝置

~各組件能穩固地組合。

☐ 能 can

☐ 不能 cannot

~The components of the periscope can be firmly assembled.

~能觀察到比視線高的東西。

☐ 能 can

☐ 不能 cannot

~The periscope allows us to see an object above eye level.

~能清晰而完整地把「像」反射。

☐ 能 can

☐ 不能 cannot

~The periscope can produce a clear whole image.

我的改良項目

如何改良?

Items I have improved:

How can I improve?

☐ 鏡子的位置 ☐ The position of the mirror

☐ 鏡子的角度 ☐ The angle of the mirror

☐ 鏡子的尺寸 ☐ The size of the mirror

☐ 鏡子的數量 ☐ Total number of the mirrors

☐ 主體的尺寸 ☐ The size of the periscope

自我檢討及評估

Self-reflections and evaluations

1.相片集 Photo album

請貼上作品的相片

Photo of the product

請貼上與作品的合照

Photo of you and your product

2. 作品最出色的地方 The most outstanding part of the product:

- ☐ 外型設計 The design of the outlook
- ☐ 組件接合 Joining different components
- ☐ 反射效果 The performance of light reflection
- ☐ 尺寸比例 The dimension of the periscope
- ☐ 其他 Others: _____

3. 製作上的難點 Difficulties that I faced during the production:

- ☐ 外型的设计 The design of its outlook
- ☐ 鐳射切割機的運用 The operation of the laser cutter
- ☐ 組件之接合 Joining different components
- ☐ 鏡子角度的調校 Adjusting the angle of the mirror
- ☐ 圖案的搜集 The searching of the pictures
- ☐ 其他 Others: _____

4. 製作心得分享 Sharing of the periscope production:

5. 在整個活動中，哪個地方最讓你感到成功? 為什麼?

Which part of the activity makes you feel the most successful? Why?

反思學習 Reflections

在製作過程中，把你學會的在 ☆ 內填上顏色。

Colour the stars for what you have learnt during the production process.

S SCIENCE 科學

☆ 認識光是直線進行的科學概念，及它在「全方位潛望鏡」的應用

☆ Understand the scientific fact that light travels in a straight and applies it to make a periscope

☆ 了解鏡子的特性，利用兩次反射的過程把「左右倒轉」的「像」修正

☆ Understand the properties of a mirror; use two mirrors so that it can produce an image that is not laterally inverted

☆ 從生活中找出運用了光的反射原理的例子

☆ Find out examples that apply the law of reflection in our life

T TECHNOLOGY 科技

☆ 選用合適的物料及運用鐳射切割機來製作「全方位潛望鏡」

☆ Choose appropriate materials and use a laser cutter to produce a "all-direction periscope"

☆ 能於「全方位潛望鏡」之中加入適當尺寸的鏡子，讓潛望鏡能觀察比視線高的東西

☆ Can use a mirror with a sensible dimension so that it can see an object above eye level

☆ 善用公平測試來了解潛望鏡能看到清晰而完整的「像」的原因：

- 1.) 鏡子的數量
- 2.) 鏡子組合的角度

☆ Use a fair test to investigate the factors that affect the integrity and clarity of an object:

- 1) Number of mirrors

- 2) The angle between the mirror and the wall of the periscope

E ENGINEERING 工程

☆ 能利用 AutoCAD 繪畫工具來設計及準確地繪畫「全方位潛望鏡」的外型及尺寸比例

☆ To use AUTOCAD to design and accurately draw the outlook of the "all-direction periscope" with sensible dimensions

☆ 能透過測試及改良來提升「全方位潛望鏡」的「觀察景物」效果

☆ To improve the performance of the "all-round periscope" through tests and modifications

M MATHEMATICS 數學

☆ 懂得調校鏡子組合的角度，令「全方位潛望鏡」能看到清晰而完整的「像」

☆ To measure the angle of the mirror so that it may optimize the performance of the "all-round periscope"

生活放大鏡

Daily life magnifier

試從生活中找出運用了「反射原理」的例子

From your daily lives, find some examples that apply the law of reflection of light

A large rectangular area defined by a dashed line, intended for students to write their examples of the law of reflection in daily life.

活動點滴 Comments

你在這次活動中有什麼收穫?試利用一篇短文來表達。

Write a short essay about your learning in this STEM activity?

第一段：介紹你在製作前的準備工作及如何構思設計

Paragraph 1: Introduce your preparatory work and the ways you gather your ideas.

第二段：分享你在製作過程中感受最深的地方，當中遇到甚麼困難及如何解決

Paragraph 2: Share the most memorable moments during the production process. What difficulties did you face and how did you deal with them?

第三段：通過這次活動，你學會了甚麼?你在未來製作活動上有什麼期望與目標?

Paragraph 3: What have you learnt in this activities? Do you have any expectation and objectives in your future projects?

																			5
																			10
																			15

同學互評 Peer evaluations

同學姓名 Name of my classmate : _____

請在○內加上✓。Put a ✓ in the ○.

評估項目 Evaluation items											
1. 同學能整理和組織蒐集得來的資料 My classmate can organize the data collected. (最低) 1 2 3 4 5 6 7 8 9 10 (最高) Lowest ○ ○ ○ ○ ○ ○ ○ ○ ○ Highest											
2. 同學懂得利用組織概念圖仔細策劃整個設計 My classmate can organize their ideas with concept map(s). (最低) 1 2 3 4 5 6 7 8 9 10 (最高) Lowest ○ ○ ○ ○ ○ ○ ○ ○ ○ Highest											
3. 同學能在設計中發揮創意 My classmate is creative. (最低) 1 2 3 4 5 6 7 8 9 10 (最高) Lowest ○ ○ ○ ○ ○ ○ ○ ○ ○ Highest											
4. 同學能積極參與活動 My classmate can actively participate in the activity. (最低) 1 2 3 4 5 6 7 8 9 10 (最高) Lowest ○ ○ ○ ○ ○ ○ ○ ○ ○ Highest											
5. 同學能盡力完成自己的工作 My classmate has tried his/her best to complete their tasks. (最低) 1 2 3 4 5 6 7 8 9 10 (最高) Lowest ○ ○ ○ ○ ○ ○ ○ ○ ○ Highest											
6. 同學能清楚介紹製成品 My classmates can present their product clearly and systematically. (最低) 1 2 3 4 5 6 7 8 9 10 (最高) Lowest ○ ○ ○ ○ ○ ○ ○ ○ ○ Highest											

家長對子女的評估 Parent evaluations

請家長根據孩子是次 STEM 學習的表現，在適當的空格內加「✓」

Put a ✓ in the appropriate boxes to evaluate your child's performance in the STEM learning.

評估項目 Evaluation Items		評估表現 Performance		
		表現優良 Excellent	合乎標準 Good	有待改善 Needs improvement
學會學習 Learning to learn	1.能善用不同的途徑搜集資料 Can collect information through different ways.			
	2. 主動及自發性地完成 STEM 自學手冊 Can complete the booklet actively and independently.			
	1. 積極投入研習工作 Actively participate in the whole study process.			
學會生活 Learning to live	1.遇到問題時，能主動尋求解決方法，並與家人商討 Can seek help when he/she faced difficulties.			
	2.能適當地安排研習時間 Can allocate the study time appropriately.			

其他意見 Comments :

家長簽署

Parent's Signature:

老師對學生能力的評估

Teacher's evaluation on your process

範疇 Category	準則 Criterion	評估 Assessment		
		甚強/表現 出色 Excellent	可以/尚 算滿意 Good	未能呈現/仍需 努力 Needs improvement
協作能力 Collaboration Skills	1. 欣賞他人 Appreciate others			
	2. 有效地進行小組工作 Work effectively in a team			
	3. 協商能力 Negotiate with groupmates			
溝通能力 Communication Skills	1. 採用恰當溝通方法 Communicate through effective means.			
	2. 運用準確及合適的資料表達自己意見 Express yourself with accurate and appropriate information			
	3. 有系統地組織內容 Organize content systematically			
創造力 Creativity	1. 解決問題的能力 Can suggest creative ways to solve problems			
	2. 創意的態度 Can demonstrate a positive attitude to create			
	3. 創意思想及策略 Can think and plan innovatively			
明辨性思考 能力 Critical Thinking Skills	1. 對蒐集資料進行探究 Conduct research on the data collected			
	2. 對蒐集資料作判斷 Make judgments on the data collected			
	3. 從資料及知識中建立自己的觀點 Can construct your own view based on the data collected and related knowledge			

運用資訊科技能力 IT Skills	1. 明智地使用資訊科技 Make wise use of IT			
	2. 利用資訊科技去尋找、吸收、分析處理各項資料 Effective apply IT to explore, utilize information and make analysis			
	3. 利用資訊科技養成自學習慣 Develop a self-learning habit through IT			
數學能力 Mathematical Skills	1. 能夠用適當的方法收集數據 Can use appropriate methods to collect data			
	2. 建立有系統的數據庫 Build a systematic database			
	3. 分析數據 Analyse the data collected.			
解決問題能力 Problem Solving Skills	1. 分析有關資料 Analyse the relevant information			
	2. 採取最合適方法解決問題 Choose the most optimal way to solve a problem			
	3. 檢討方案成效 Evaluate the effectiveness of a solution			
自我管理能力的 Self-management Skills	1. 對工作積極和主動 Work positively and actively			
	2. 定下適切的目的，計劃和行動來達成目標 Set objectives, plans and actions to achieve your goals			
	3. 懂得管理時間、金錢和其他資源 Demonstrate time management, financial management and resource management skills			
自學能力 Self-learning Skills	1. 提升學習效能 Improve learning effectiveness			
	2. 提升學習態度 Improve learning attitude			
	3. 掌握研習能力 Master study skills			

老師對學生作品的評估：

Teacher's evaluation on your product

	未能呈現 Not shown in the product	仍需努力 Needs improvement	尚算滿意 Good	表現甚強 Very good	表現出色 Excellent
設計新穎 Creativity					
反射效果 Reflection effect					

評分準則 Assessment Guidelines：

1. 設計圖 Design of the model 5%

1-2 分	3 分	4 分	5 分
只能繪畫出作品部分外型，且整潔欠佳 Can draw only part of the model; the design plot is untidy.	能繪畫出作品部分外型，但未能從圖中得知物料、比例等資料 Can draw part of the model; yet key information such as materials and dimensions are missing.	能完成作品的設計圖，但尚欠部分資料，仍欠細緻 Can draw the model; yet some information is not clearly presented.	能準確繪畫作品的外型、比例及所需物料，詳盡和細緻 Can draw the model accurately, with its outlook, dimensions and materials clearly presented in detail
()分 Mark	()分 Mark	()分 Mark	()分 Mark

2. 製作流程圖 Steps 5%

1-2 分	3 分	4 分	5 分
<p>只能完成製作流程圖中一個或以下部分，令人對製作過程模糊不清</p> <p>Can only show one steps; the whole procedures are presented ambiguously.</p>	<p>只能完成製作流程圖中兩個或三個部分，使人對製作過程有初步了解</p> <p>Can only show two or three steps; the whole procedures are briefly presented.</p>	<p>只能完成製作流程圖中義四個或五個部分，使人對製作過程有清晰的了解</p> <p>Can only show four or five steps; the whole procedures are adequately presented.</p>	<p>能完成製作流程圖中六個分，表達完整及清晰，令人對製作過程一目了然，準確細緻</p> <p>Can show six steps; the presentation is neat, clear and complete.</p>
()分 Mark	()分 Mark	()分 Mark	()分 Mark

3. 活動點滴 Comments 5%

0-1 分	2-3 分	4 分	5 分
<p>未能利用文章把學會的知識和技能表達出來</p> <p>The acquired knowledge and skills cannot be presented in an essay.</p>	<p>只能局部把學會的知識和技能利用文章表達出來，但沒有把內容作系統的組織，分類欠條理</p> <p>Only part of the acquired knowledge and skills are presented in an essay; yet the content is not organized logically and systematically.</p>	<p>能把學會的知識和技能利用文章表達出來，清晰整潔有條理，使人容易理解</p> <p>The knowledge and skills acquired in the study process can be expressed in an essay; the presentation is neat, clear and logical.</p>	<p>能具體及詳盡地把學會的知識和技能表達出來，可見能切合主題作深入及多角度的反思</p> <p>The knowledge and skills acquired in the study process can be expressed in detail with examples; show deep reflection and multiple- perspective thinking.</p>
()分 Mark	()分 Mark	()分 Mark	()分 Mark

獎項 Awards :

最佳外型設計獎

The best design award

最佳反射效果獎

The best reflection performance
award



實用詞彙

Useful vocabulary

物料

鏡片 mirror

木板 wooden board

工具

剪刀 scissors

顏色 colour

間尺 ruler

護目鏡 safety goggles

鐳射切割機 laser cutter

游標卡尺 Vernier caliper

製作技巧

切割 cut 接駁 connect 組裝 assemble 固定 fix 檢查 check

去掉/除去 remove 安裝 install 剪裁 cut out 鑽孔 bore