

“不可思議的『摩』力”

“The Incredible Power of Friction.”

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一、旨趣 Learning Objectives

請想像以下情況，當道路變得像冰一樣光滑，這時你開著一輛沒有胎紋的車行駛在這條道路上，會發生甚麼狀況呢？再試著想像，如果世界上所有東西都變得光滑呢！

Imagine the following situation: when the road becomes as smooth as ice, and you are driving a car without any tire tread on this road, what do you think would happen? Now, try to imagine if everything in the world became smooth!

原來，我們之所以可以在路上行走，可以拿起物品，可以做著生活中看似簡單的事，其實都是因為摩擦力。摩擦力無處不在，因此生活中有許多設計都和摩擦力的應用有關，就讓我們一起來看看不同的摩擦力怎麼影響我們的生活。

It turns out that the reason we can walk on the road, pick up objects, and do the seemingly simple tasks in our daily lives is all thanks to friction. Friction is everywhere, and many designs in life are related to its application. Let's explore how different types of friction affect our daily lives.

本次主題的設計是藉由書本交疊拉扯感受摩擦帶來的力量，以及不同材質的坡面，如何影響車子滑行的距離來體驗摩擦力的應用，生活中摩擦力無所不在。

The theme of this activity is designed to help you feel the power of friction by pulling stacked books and observing how different materials on inclined surfaces affect the sliding distance of a car, allowing you to experience the application of friction. Friction is truly everywhere in our lives.

二、活動設計 Event Design

(一)活動一「誰都別想輕易拉開」Activity 1- Not Easy to Pull Apart.

當兩書交疊時，其中間部位要比兩端的書脊處來得厚，每張書頁從書脊延伸至交疊處時，會產生一個傾角。施力往外拉時，書頁繃緊造成傾角變小，產生向內壓的正向力，進而增加摩擦力，故不易將兩本書拉開。

When two books overlap, the middle part is thicker than the spines at both ends. As each page extends from the spine to the overlapping area, it creates an angle of inclination. When force is applied to pull the books apart, the pages tighten, reducing the angle of inclination, which generates an inward compressive force. This, in turn, increases friction, making it difficult to pull the two books apart.

(二)活動二「看誰跑得遠」 Activity 2- Who Runs the Farthest

利用三種不同材質進行玩具車的滑行動試 (80 號砂紙、不織布、塑膠透明片)。實驗設計用不同材質的板子，玩具車從固定坡道往下推滑，其滑動速度以及滑動距離會根據不同材質將會不一樣。若是摩擦力較小，滑動速度快且遠，若摩擦力大，則反之。

Conduct a sliding test for toy cars using three different materials (#80 sandpaper, non-woven fabric, and a transparent plastic sheet). The experiment is designed with boards made of different materials, and the toy cars are pushed down from a fixed ramp. The sliding speed and distance will vary depending on the material used. If the friction is low, the car will slide faster and farther, whereas if the friction is high, the opposite will occur.

三、實驗器材 Experimental Materials

(一)玩具車 toy cars

(二)滑動板:貼有 80 號砂紙、不織布、塑膠透明片

Sliding panels covered with #80 sandpaper, non-woven fabric, and transparent plastic sheets.

(三)書本 books



四、活動過程(操作步驟) Operational steps

(一)活動一「誰都別想輕易拉開」: Activity 1- Not Easy to Pull Apart.

1.將兩本書的隨意的內頁各一層互相交疊，試著拉拉看，感受是否容易將書本拉開。

Step 1: Take a page from each of the two books and lay them on top of each other.

Then, try to pull the books apart and see if it's easy to do!

2.再將兩本書的內頁多頁層層交疊，再試著拉拉看，感受是否容易將書本拉開。

Step 2: Now take several pages from each book and stack them on top of each other. Then, try to pull the books apart and see if it's easy to do!



(二)活動二「看誰跑得遠」:Activity 2- Who Runs the Farthest

1.三台玩具車同時從三種不同材質斜坡滑下，並在斜坡末端放置積木

Step 1: Three toy cars slide down three different material ramps at the same time, and blocks are placed at the end of the ramps.

2.玩具車滑下時，看看哪種材質的斜坡面讓玩具車可以滑行的最遠

Step 2: When the toy cars slide down, see which type of ramp material allows the cars to slide the farthest.

五、原理探討 Principle Discussion

摩擦力產生需要幾個條件：第一就是物體之間要相互接觸；第二就是物體之間要有相互擠壓的作用；第三就是物體表面要粗糙；第四就是物體要有相對運動趨勢或者相對運動。只有滿足了這四個條件才會產生摩擦力。擦力是兩個表面接觸的物體之間有相對運動或者有相對運動趨勢的時候產生的一種力。

Friction requires several conditions to occur: First, the objects must be in contact with each other; second, there must be a compressive force between the objects; third, the surfaces of the objects must be rough; and fourth, there must be a tendency for relative motion or actual relative motion between the objects. Only when these four conditions are met will friction occur. Friction is a force that arises between two surfaces in contact when there is relative motion or a tendency for relative motion.