GD: Wave Introduction
活動單元: 波浪介紹

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Names	Student ID (last 7 digits)							Gr

1. Introduction 簡介

In this guided discovery activity, you will perform virtual experiments with two different public domain physics simulations dealing with GD: Wave Introduction. Before you start answering the questions, play with each simulation. Get familiar with each of the different effects, buttons and tabs of the animations.

在這個引導的發現活動中，您將使用涉及波浪的兩個不同的公共領域物理模擬執行虛擬實驗，在你開始作答問題前，玩玩看每個模擬實驗，熟悉動畫的每個不同效果，按鈕和標籤。

2. Mechanical Waves on a String 繩上的機械波

2.1 Download, Run and Play with the PhET Simulation: “Waves on a String”. 下載，運行和玩 PhET 模擬: 「繩波」

2.2 [Select: Oscillate] Please find five different parameters will affect the wave characteristics. Draw pictures to show the effect of changing each of these parameters individually.(before and after) **[**選擇**:** 振盪**]** 請找出 **5** 種參數能夠改變波型特徵，並繪製圖片以顯示分別更改每個參數的效果 **(**前後圖差異**)**。

	a. English 英文	b. Chinese 中文	c. Picture before 前圖	d. Picture after 後圖
1				
2				
3				
4				
5				

2.3 Systematic Experimentation [Select: Oscillate, No damping, No end] Find the relationship between the **λ** and the frequency **(f).** 系統實驗 [選擇: 振盪, 無阻尼, 無邊界] 找出波長 **λ** 和頻率 **(f)** 之間的關係。

a. Write down the results in the table. 將數值紀錄在下列圖表
b. Draw a graph. 繪製數線圖
c. Fit the data to an equation. 將數據擬合到方程式中

(a) frequency (f) 頻率	λ (cm)	(b) graph 圖形	(c) Equation 方程式

d. (i) Using the ruler and the timer, find the velocity ($\bar{\mathbf{v}}_{wave}$) of the peak of the wave in the x-direction.使用尺和計時器，在 x 方向上找出波峰的速度 ($\bar{\mathbf{v}}_{wave}$) (ii) Does it depend on frequency? 它是否取決於頻率？

(i)	(ii)
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e. Compare your answer to part (d) with the equation you got in part (c). Comment on the result. 將你在 d 部分得到的答案與 c 部分得到的方程進行比較，並評論結果。

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2.4 [Select: Oscillate] Observe the wheel. Change the frequency(f) of the waves and record the angular velocity (ω) of the wheel? Record the Ratio. [選擇: 振盪] 觀察車輪，改變波浪的頻率 (f)，並記錄車輪的角速度 (ω)，寫下比率。

frequency 頻率 (f)	Angular Velocity 角速度 (ω)	Ratio 比率 (ω/f)

2.5 [Select: Oscillate] Look at the wheel. Write down why the wheel creates a sinusoidal wave. [選擇: 振盪] 注意輪子，寫下為何輪子轉動可以使繩子產生正弦波。

3. Water Waves 水波

3.1 Download, Run and Play with the PhET Simulation: “Wave: Interference” TAB: [Waves] 下載，運行和玩 PhET 模擬:「波的干涉」標籤: [波的介紹]

3.2 [Select: Water Icon] How does changing the frequency (f) of the drip (disturbance) affect the characteristics of the water waves? (i) What changes? (ii) What remains the same? [選擇: 水圖標] 改變水滴的頻率 (f) (擾動) 會如何影響水波的特性? (i) 什麼發生了變化? (ii) 什麼保持不變?

(i)	(ii)

3.3 How does changing the amplitude (A) of the drip affect the characteristics of the waves? (i) What changes? (ii) what remains the same? 改變水滴的振幅 (A) 會如何影響波的特性? (i) 什麼發生了變化? (ii) 什麼保持不變?

(i)	(ii)

3.4 Sketch the water waves from both the top and side views. Label the distance between successive peaks and valleys as the wavelength (λ) of the wave in each of your sketches. Label the height of the wave as 2A. 描繪水波的俯視圖及側面的剖面圖，並將每個連續波峰和波谷之間的距離標記為波長 (λ)，將波的高度標記為 2A。

Top 俯視	**Side 側面**

3.5 Based on the experimental data, express mathematically how the wavelength (λ) of the wave depends upon its frequency (f)? How were you able to come to this conclusion? 根據實驗數據，以數學方式表達波的波長 (λ) 是怎麼取決於其頻率 (f) 的? 你是如何得出這個結論?

3.6 Come up with a method to determine the speed (v) of a water wave from the experimental data. (i) Outline your procedure. (ii) Share your results below. You should run several trials and average your results. 從實驗數據想出一個方法來確定水波的速度 (v)。(i) 列出方法的大綱 (ii) 在下面分享你的成果。你應該進行多次試驗並對結果進行平均。

(i)		

3.7 Change the frequency and amplitude of the drip? 改變水滴的頻率和振幅？

a. How does changing the frequency (f) of the drip (disturbance) affect the speed (v) of the waves? 改變水滴頻率 (f) (擾動) 會如何影響波速 (v)?

b. What effect does changing the amplitude (A) of the drip have on the speed (v) of the waves? 改變滴的振幅 (A) 會對波速 (v) 有什麼影響？

3.8 How does amplitude (A) change with distance (r) from the drip (disturbance)? How could you tell? What might be causing this to happen? Can you suggest a mathematical equation to relate A to r. i.e A(r)? (A) 水滴的距離 (r) 改變會對振幅 (A) 產生什麼影響? 你怎麼知道? 是什麼導致這種情況發生？你能建議一個數學方程式來將 A 與 r 聯繫嗎? 例如: A(r)

4. Sound Waves 聲波

4.1 [Select: Sound Waves] Using the method you developed in the previous activity (§3.2e), (i) measure the speed of a sound wave. (ii) Compare this with the 'accepted' value of the speed of sound in the air (c=343 [m/s]). What might be some reasons for the discrepancies between your calculated value and the accepted value? [選擇: 聲波] 使用你在上一個活動中開發的方法 (§3.2e) (i) 測量聲波的速度 (ii) 將此與空中聲速的“理論值”進行比較 (c=343 [m/s])，你的計算值和理論值之間的差異可能是什麼原因造成的?

(i)	(ii)

4.2 (i) How does the sound intensity (amplitude or 'volume') change as the separation (r) between the source and the observer increases? How could you tell? (ii)What might be causing this to happen? (i) 聲音強度 (振幅或“音量”) 如何隨著聲源與觀察者之間的距離 (r) 的增加而變化? 你怎麼知道? (ii) 有什麼可能導致這種情況發生？

(i)	(ii)

4.3 Compare the change in intensity with distance from source of the sound and water waves. (i) Which changes the fastest? (ii) Why? 比較聲波和水波的強度改變 (i) 哪一個改變的比較快? (ii) 為什麼?

(i)	(ii)

4.4 Turn the Audio on and listen to the waves. Change the amplitude (A) of the waves. How does the volume of the sound change? If I double the amplitude of the waves, how does the volume you hear change? What does this tell you about your ears? 打開音頻並收聽海浪的聲音，更改波的振幅 (A)，聲音的音量有何變化? 如果我將波的振幅加倍，你聽到的音量會有何變化? 這告訴你關於你的耳朵的什麼事?

4.5 Turn the Audio on and listen to the waves. Describe what happens as you change the frequency (f) of the waves leaving amplitude (A) constant. Do all frequencies of sound seem to have the same volume to you? 打開音頻並收聽海浪的聲音，描述當你改變頻率 (f) 並保持振幅 (A) 不變時，會發生什麼? 所有聲音頻率對你來說聽起來都具有相同的音量嗎?

5. Light Waves 光波

5.1 [Select: Light Waves] Use the simulation to determine the wavelengths of the following colors of light. Fill in the table to the right. [選擇: 光波] 使用模擬來確定以下顏色的光的波長，並填寫右邊的表格。

Colour 顏色	顏色	Wavelength λ [nm]
Red	紅	
Orange	橙	
Yellow	黃	
Green	綠	
Blue	藍	
Violet	紫	

Table 1: Colour Perception and Wavelength

5.2 Using the methods you developed in the previous sections, (i) determine the speed (v) of a light wave. (ii) Does this speed depend on the frequency (colour) of light (f)? Amplitude (A)? (iii) Compare this with the 'accepted' value of the speed of light. What might be some reasons for any discrepancies between your calculated value and the accepted value? 使用你在前幾部分中開發的方法， (i) 判斷光波的速度 (v) (ii) 這個速度取決於光的頻率 (f, 顏色)嗎? 振幅 (A)? (iii) 將此與光速的理論值進行比較。有什麼原因可能造成你的計算值與理論值之間的差異?

(i)	(ii)	(iii)

6. Student Comments 您的意見

6.1 Did you enjoy the activity? Choose one 你喜歡這個活動嗎？選一個

□□ HATED 憎恨 □ 25% □ 50% 馬馬虎虎 □ 75% □ LOVED 喜爱

Why? 為什麼？

6.2 Was this activity helpful for your understanding of physics? 這項活動對您對物理學的理解有幫助嗎？

□ No 連一點幫助都沒有 □Some 一點幫助 □ So-so 馬馬虎虎 □ 75% □ 有幫助 Yes

6.3 Suggest additional questions to ask concerning any of the simulations. (If your question is added, you get 1% bonus marks for the course!) 提出有關任何模擬的其他問題。(如果您添加的問題被使用，您將獲得該課程 1%的獎勵分數！)

Activity 活動	Suggested Question 建議的問題	Answer to suggested question 回答建議的問題