

主題：蛙！是你在叫嗎？聽「雄」共鳴的秘密

Topic: What a Croak! Let's Hear the Science!

校名：高雄市小港區鳳陽國小

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一、活動設計理念與核心素養 Activity Concept & Core Competencies

本活動以熱門特寵「南美角蛙」為起點，結合真實生物觀察、數位聽覺辨識與動手做科學玩具。引導學生透過肉眼觀察破除生物分類迷思，進而探討兩棲類「以氣流振動聲帶、鳴囊共振放大」的發聲機制。

最後，學生動手組裝「彈力撞擊蛙鳴器」，將角蛙的生物構造轉化為物理科學模型。在做中學的趣味歷程中，親身體驗摩擦力、彈力回彈、聲波震動與共振腔放大等核心物理概念，落實探究實作與跨領域科學素養。

This activity starts with the popular pet—the **Horned Frog**—combining live animal observation, sound matching, and a hands-on science craft.

- **Spot the Difference:** Students observe the Horned Frog up close to bust classification myths between frogs and toads.
- **Explore Frog Sounds:** Students discover how frogs make sounds—lung air vibrates the vocal cords, and the vocal sac amplifies the volume through resonance.
- **Make a Cup Croaker:** Make a Cup Croaker: Students build their own frog-croaking toy using a paper cup, rubber band, string, and bead to turn biology into physics, exploring how friction, bounce, and cup resonance create loud croaking sounds!

二、關卡流程與詳細設計內容

第一關：角蛙是蛙？還是蟾蜍？角蛙身世大解密（實體觀察）

設計目標：運用科學特徵破除外觀迷思，學會辨識兩棲類的分類與生態適應，並透過聽覺盲測啟發對蛙類多樣叫聲的好奇心。

活動內容：

1. **實體引導**：現場展示活體南美角蛙飼養箱，以其圓胖身型、巨大嘴巴與特殊花紋引發參與者的好奇與探究動機。
2. **特徵辨識**：引導闖關者比對兩大類群的典型特徵。
 - (1)**常見青蛙**：皮膚光滑濕潤、後腿修長善跳躍與游泳、上顎具齒、無耳後腺。
 - (2)**典型蟾蜍**：皮膚粗糙佈滿疣粒、後腿粗短多爬行且不擅游泳、口中無齒、頭部兩側具明顯耳後腺（大毒囊）。
3. **實體特徵對照**：引導闖關者比對現場角蛙與生活環境
 - (1)**棲地觀察**：生活於乾濕分離環境（具穩定淺水區與潮濕陸地），不擅長游泳。
 - (2)**外觀比對**：體態圓短、後腿粗壯像蟾蜍；表皮雖有顆粒突起，但質地濕潤，且眼睛後方完全沒有蟾蜍的耳後腺（無毒）；頭部眼睛上方則長有特殊的三角形肉質突起（小角）。
4. **科學分類解密**：公布答案——從骨骼構造與外部形態來看，角蛙的特徵其實更接近蟾蜍（但角蛙完全無毒，沒有蟾蜍的耳後腺，因此非常適合做為寵物飼養）；不過在現代生物分類學上，牠既非典型的赤蛙也非蟾蜍，而是屬於獨立的兩棲綱無尾目「角花蟾科」，是來自南美洲雨林落葉堆中的埋伏型掠食者。眼睛上方的三角形肉質小角的主要功能就是用來偽裝，讓牠在落葉堆裡偽裝成枯葉邊緣，敵人看不見牠，獵物走過去就被一口吃掉！
5. **聽音盲測猜真假**：關主利用平板播放臺灣常見的莫氏樹蛙（連續笑聲/火雞叫）、黑眶蟾蜍（機關槍打嗝聲），以及主角南美角蛙（渾厚低沉牛叫聲），並隨機穿插「紙杯蛙鳴器」現場拉動的聲音，讓闖關者挑戰分辨哪段是真青蛙叫、哪段是科學玩具。

Station 1: Frog or Toad? The Horned Frog Mystery

Goal: Break appearance myths to identify amphibians and challenge ears with a frog sound guessing game!

Steps:

- **Step 1: Live Observation**

Look closely at the live South American Horned Frog in the tank. Notice its round body, huge mouth, and unique skin patterns.

- **Step 2: Frog vs. Toad**

True frogs usually have smooth skin, long legs for jumping, and tiny teeth. True toads have bumpy, dry skin, short legs for crawling, and large poison glands (parotoid glands) behind their eyes.

- **Step 3: Check the Clues**

The Horned Frog looks chubby like a toad, but it has **no poison glands** behind its eyes! It also has cool, horn-like flaps above its eyes.

- **Step 4: The Big Secret**

Is it a frog or a toad? It belongs to its own special family: **Ceratophryidae (Horned Frogs)**! It is completely non-toxic, loves hiding in leaf litter, and is an ambush predator from South American rainforests.

- **Step 5: Sound Guessing Challenge**

Listen carefully to the tablet audio! Can you tell the difference between real frog calls (tree frog, Asian common toad, Horned Frog) and the homemade paper cup croaker? Which one is real? Which one is science?

第二關：蛙鳴秘密與模型原理大對決

設計目標：解析兩棲類「氣流、聲帶與鳴囊」的發聲與放大機制，並將生物器官構造抽象轉化為「摩擦、彈力撞擊與共鳴腔」的物理對照模型。

活動內容：

1. **鳴囊影像解說：**播放特寫短片，展示角蛙叫聲響亮的秘密——下巴鼓出巨大的單咽下外鳴囊。
2. **兩棲發聲三步驟拆解：**
 - (1)**動力來源（強力充氣）：**收縮身體肚子，像擠風箱一樣將肺部空氣用力往喉嚨推。
 - (2)**製造發聲（聲帶震動）：**空氣快速衝過喉嚨的「聲帶」，讓它像橡皮筋一樣震動，發出微小的聲音。
 - (3)**放大音量（鳴囊共鳴）：**聲音衝進下巴的「鳴囊」，下巴像吹泡泡一樣鼓起來，空氣在裡面產生劇烈共鳴，把聲音放大幾十倍，變成響亮的「呱」聲！。

科學小關鍵：聲音要變大，需要一個中空的空間來產生「共鳴」。角蛙的鳴囊就是牠的天然共鳴箱！

3. 蛙鳴器發聲原理對照（構造對比）：

(1)指滑繩結（動力）：對應角蛙「肚子擠壓空氣推動氣流」。

手指順著棉繩滑動，遇到突出的「繩結」時摩擦力瞬間增大，順勢將串珠向外拉伸。

(2)串珠撞擊杯底（製造發聲）：對應角蛙「聲帶高速震動」。

手指離開「繩結」時，摩擦阻力驟減，橡皮筋彈性恢復力隨之將串珠彈回，帶動「串珠」猛烈撞擊杯底，快速連續敲擊產生微小的撞擊聲。

(3)紙杯共鳴（放大音量）：對應角蛙「下巴鳴囊共振放大」。

撞擊的震動傳進中空的「紙杯」，杯內的空氣與杯壁產生共鳴，把敲擊聲放大幾十倍，變成響亮的蛙鳴！

Station 2: The Mystery of Frog Calls: Biology vs. Science Model

Goal: Discover the three steps of frog calling and map them directly to our physics model.

Steps:

- **Step 1: Watch the Vocal Sac Video**

Watch the close-up video of a Horned frog calling. Look at its chin inflate like a giant bubble! This special bubble is called a **vocal sac**.

- **Step 2: 3 Steps of Frog Calling**

- **1. Power (Push Air):** The belly pushes air from the lungs up to the throat like an air pump.
- **2. Sound (Vibrate):** Fast air vibrates the vocal cords in the throat like rubber bands, making tiny sounds.
- **3. Volume (Resonance):** The vocal sac inflates with air, creating **resonance** that amplifies the sound over ten times into a loud croak!

- **Science Key Point:** To make a sound loud, you need an empty hollow space for **resonance**. The frog's vocal sac is its natural biological loudspeaker!

- **Step 3: The Physics Behind the Frog**

- **1. Power (Slide on Knots):** Fingers sliding over string knots create friction, pulling the bead away. (Like the frog's belly pushing air!)
- **2. Sound (Bead Strikes Cup):** The rubber band snaps the bead back to hit the cup bottom, creating vibrations. (Like vocal cords vibrating!)

- **3. Volume (Cup Resonates):** The hollow cup resonates with the air, turning tiny taps into a loud croak! (Like the chin vocal sac amplifying sound!)

第三關：呱呱製造所——蛙鳴器動手做

設計目標：親手組裝蛙鳴器，體驗摩擦與彈力撞擊，發現紙杯放大聲音的秘密。

活動內容：

1. 動手做蛙鳴器

- (1) **步驟 1 (穿珠綁線)：**細繩一端穿過串珠孔洞，在串珠外側連續打 2 次結固定（打雙重結防脫落）。
- (2) **步驟 2 (製作摩擦節點)：**在細繩本體上連續打上 5 個繩結（每個間距約 1 公分，作為手指滑動的摩擦凸起點）。
- (3) **步驟 3 (穿珠套筋)：**將完整的橡皮筋穿過串珠孔洞（串珠同時穿有細繩與橡皮筋）
- (4) **步驟 4 (製作卡榫)：**用安全剪刀在杯底邊緣剪 2 道約 0.3 公分小縫（卡住橡皮筋使串珠固定於杯底中央）；再於杯口左右兩側各剪 2 道小縫（固定拉緊的橡皮筋）。
- (5) **步驟 5 (安裝彈力裝置)：**將串珠貼緊杯底，穿過串珠的橡皮筋兩端順著杯底小縫拉出，沿著杯身向外向上拉展，緊扣在杯口兩側的卡榫小縫中固定，形成彈性回彈構造。
- (6) **步驟 6 (試拉體驗)：**一手穩握杯身，另一手拇指與食指輕捏細繩，由上往下平穩順滑（輕拉即可引發最佳彈力回彈，無須大力拉扯），感受逼真的蛙鳴！

Station 3: Make Your Own Cup Croaker

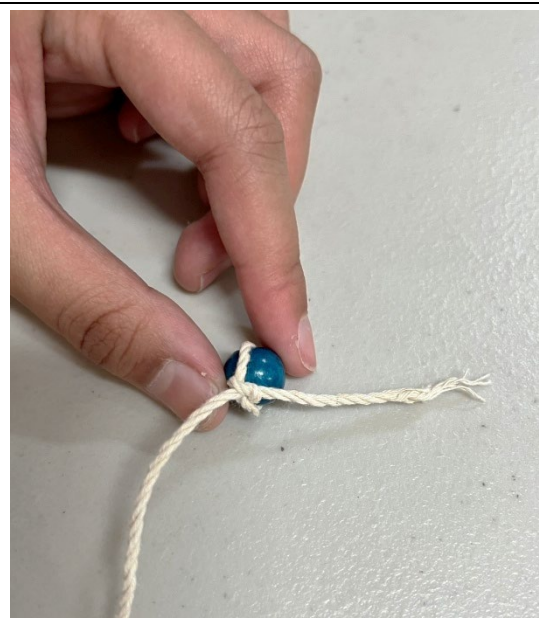
Goal: Build a cup croaker to explore friction, bounce, and sound amplification!

Activity Content:

Make Your Own Cup Croaker (Step-by-Step)

- **Step 1 (Thread & Tie the Bead):** Thread one end of the string through the bead hole and tie a double knot on the outside to secure it.
- **Step 2 (Make Friction Knots):** Tie 5 knots consecutively along the string (about 1 cm apart) to serve as friction bumps for your fingers.
- **Step 3 (Add the Rubber Band):** Thread an uncut rubber band through the bead hole (now the bead holds both the string and the rubber band).

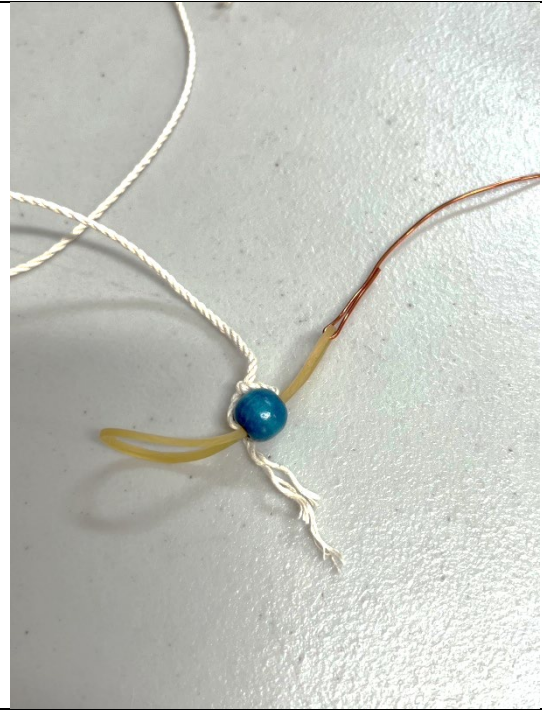
- **Step 4 (Cut Locking Slots):** Use safety scissors to make two small slits (about 0.3 cm) along the bottom rim of the cup (to center and secure the bead). Then, cut two small slits on each side of the cup's top rim (to lock the stretched rubber band).
- **Step 5 (Assemble Elastic Mechanism):** Hold the bead firmly against the bottom center of the cup. Slide both ends of the rubber band through the bottom slits, stretch them up along the outer cup sides, and lock them securely into the top rim slits to create a spring-back mechanism.
- **Step 6 (Pull & Test):** Hold the cup with one hand, pinch the string lightly between the thumb and index finger of your other hand, and slide down smoothly. (A gentle slide creates the best bouncing taps—no need to pull hard!) Enjoy the realistic frog croak!



Step 1 : Thread & Tie the Bead



Step 2 : Make Friction Knots



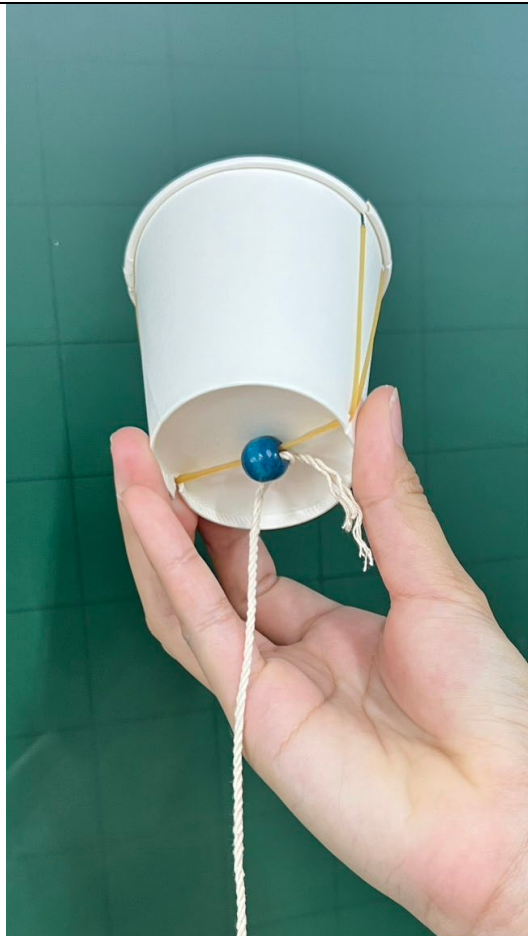
Step 3 : Add the Rubber Band



Step 4 : Cut Locking Slots



Step 5 : Assemble Elastic Mechanism



Step 6 : Pull & Test