自然領域教學單元案例

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Learning focus</td><td>學習內容
Learning content</td><td>INa-Ⅲ-8 熱由高溫處往低溫處 傳播，傳播的方式有傳導、對流和輻射，生活 中可運用不同的方法 保溫與散熱。</td><td rowspan="2">核心素養
Essential literacy</td><td colspan="2" rowspan="2">自-E-A3 具備透過實地操 作探究活動探索 科學問題的能力， 並能初步根據問 題特性、資源的有 無等因素，規劃簡 單步驟，操作適合學習階段的器材 儀器、科技設備及 資源，進行自然科學實驗。</td></tr>
<tr><td>學習表現
Learning behavior</td><td>po-Ⅲ-1能從學習活動、日常經驗 及科技運用、 自然環境、書 刊及網路媒體等察覺問題。
ah-Ⅲ-1利用科學知識 理解日常生活觀察到的現象。</td></tr>
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<tr><td colspan="2">學習目標
Learning objectives</td><td colspan="4">By the end of the course, students will be able to
2-1 能應用熱傳導的特性到生活中
Apply heat conduction’s characteristics to daily life and use properly.
2-2 能藉由觀察實驗理解熱在水和空氣中如何傳播
Understand how heat is transferred/ spread in water and air by observing experiment.
能小心正確地操作實驗
Operate the experiment carefully and correctly.
2-3 由生活經驗認識太陽的傳熱方式
Know how does sun transfer/spread the heat from daliy experiences.
2-4 能了解並比較各種材料的保溫效果會不同
Understand and compare different materials have different effects of heat Preservation.</td></tr>
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教學設備／資源 Teaching aids/ sources	Video [Make a Convection Heat Powered Windmill - Fun Kids Science Experiments] https://www.youtube.com/watch?v=v2bYpjMDFVo
語言學習目標	Language ***of*** learning
	heat conduction(熱傳導)、material(材料)、transmit(傳播)、accelerate /speed up(加速)、slow down(減緩)、burning/scald(燙傷)、oven mitt(隔熱手套)、vessel(容器)、insulation(隔熱材料)、Heat Convection(熱對流)、transparent(透明的)、beaker(燒杯)、alcohol column(酒精燈)、tripod(三腳架)、Ceramic Centered Iron Wire Gauze(陶瓷纖維網)、convection(對流)、wide mouth bottle(廣口瓶)、incense(暗香)、Liter box(公升盒)、partition(隔板)、Heat radiation(熱輻射)、galvanized iron sheet (建築用鐵皮)、heat preservation(保溫)、thermos cup(保溫杯)、Vacuum flask(真空層)、thermos bag(保溫袋)、aluminum foil(鋁箔)、down jacket(羽絨外套)、
	Language ***for*** learning
	1. Heat is transferred through conduction, convection and radiation. 2. Conduction happens when heat moves from a hot thing to a cold one through direct touch. Convection happens when heat moves from a hot thing to a cold one through a moving liquid or gas. Radiation happens when heat moves from a hot thing to a cold one without touching each other.

教學活動設計 Teaching activities design			
教學目標 Teaching objectives	主要問題與引導 Main questions and guides	時間 time	評量重點 Evaluation points
	【First ~ Second class】 **2-1 熱的傳導 heat conduction** **【Engage 參與】** ◆ 如果把鐵製湯匙放入裝有熱開水的杯子裡，一段時間後，再用手去拿湯匙，你發現了什麼? 湯匙的匙柄變熱了。 If we put an iron spoon into a cup of hot water and use our hands to take the spoon after a while. What do you find? The handle of the spoon becomes hotter. ◆ 想想看，當我們用火加熱物質時，熱是怎麼傳播到物質的呢? 可能是由受熱端往四面八方傳播 可能是由溫度高的一端傳像溫度低的一端 Think about it, how does the heat spread to materials when we use fire to heat it up? It could spread to everywhere from the point of receiving	10’	

	the heat. It could spread from the high temperature point to the low temperature point. ◆ 傳導：熱藉由接觸物質的方式從高溫傳向低溫的地方的傳熱方式 Spread: the way that heat transmitting from high temperature to low temperature through touching objects. ◆ 為什麼金屬湯匙加上木材或塑膠做的握把，就不容易燙手? 可能是因為材料不同，使傳熱速度不同 Why does the metal spoon made with wooden or plastic handle could be less hot for our hands? It may due to the different materials affect the speed of spreading heat. **【Explore 探索】** ◆ 不同材料的物體，熱的傳導速度相同嗎? 不同物體，熱的傳導快慢也不同 Do the different objects have the same spreading speed of heat? Different objects have different speed of spreading heat. ◆ 日常裡，加速或減緩熱傳導的設計： -塑膠或木頭材料做的握把不易傳熱，可以減緩熱的傳導 -用熱傳導快的材料製成鍋底可以加速食物煮熟 -將熱傳導較慢的紙套在熱飲料杯外層，手才不會被燙傷 -利用熱傳導慢的材料製成隔熱手套，避免拿物品時被燙傷 In our daily lives, what designs do we have to accelerate (speed up) or slow down the heat spread? -the plastic or wooden handles are not easy to spread heat and could slow down the heat spread. -using the materials which can spreading heat fast to make the bottom of the pot can speed up the cooking of food. -using the materials which spread the heat slow to cover the outside of hot drink can avoid burning/scalding our hands. -using the materials which can spreading the heat slow to make the oven mitt can avoid burning/scalding when we holding things. **【Explain 解釋】** ◆ 為什麼大多數的鍋子是用金屬材料製作? 而鍋子的握把卻使用非金屬材料? (1)金屬材料的傳熱速度較快，因此適合當作鍋子的材料 (2)鍋子是煮菜時的容器，用金屬材料製作，傳熱快，可加快煮東西速度；握把是手拿鍋子的部位，用傳熱慢的材料製作，才不會燙到 Why do most of the pots were made by metal materials? And why the handles of the pots were made of nonmetal	15’ 10’	認識熱傳導的方式，不同材質對熱傳導的速度不同，熱的傳導是由高溫傳向低溫。 Recognize the way of heat conduction, Different materials have different rates of heat conduction, and the heat conduction is from high temperature to low temperature.

	materials? (1) Metal materials can spread the heat faster, so it is suitable for being the materials of pots. (2) Pots are vessels of cooking and were made by metal materials. So it can accelerate cooking speed due to spreading heat fast. Handles are the places that our hands to hold the pots. So we won't get burn if we use the materials which spread the heat slow. **【Evaluate 評量】** ◆ 傳導速度慢的物質，適合當隔熱材料 傳導速度快的物質，適合當鍋具等物品 The materials of slow spreading speed are suitable for being insulation. The materials of fast spreading speed are suitable for being pots, etc. **Types of Heat Transfer.** https://www.youtube.com/watch?v=w-R2c6qH4IU **【Third~Fourth class】** **2-2 熱的對流 Heat Convection** **【Engage 參與】** ◆ 有什麼方法可以讓我們知道熱在水中是如何傳播呢? What ways/ methods do we have to know how does heat spread in water? 水滾了會一直往上冒泡泡，但水是透明的，無法看見熱是怎麼傳播的→可以加入一些物質在水中，可能可以幫助我們觀察 There are bobbles coming/raising up from the bottom of water when water is boiled. But water is transparent so we can't see how does heat been spread. →we can add some substances into water and it may help us to observe clearly. **【Explore 探索】** 實驗操作	5' 5' 15'	藉由實驗觀察並討論空氣的對流，並說出生活

	◆ 實驗器材：芝麻、水、燒杯、酒精燈、三腳架、陶瓷纖維網 ◆ 操作步驟： 1. 將 500ml 燒杯裝約 30ml 的熱水，並放入一茶匙芝麻，利用酒精燈在杯底加熱 2. 左右移動酒精燈，觀察芝麻在水中移動的情形 ◆ 注意事項： 1. 幫酒精燈添加酒精時務必先熄火，酒精只能加至八分滿 2. 不慎引燃物品時，可利用濕抹布滅火 3. 熄滅酒精燈時，拿燈罩從火焰側邊蓋熄 ◆ 討論： 1. 燒杯內的水受熱時，芝麻在水中是如何移動的? 如果在燒杯中間的底部加熱，芝麻會從底部上升，再向兩邊下降，形成對流； 如果在燒杯的一端底部加熱，芝麻會從底部往上升，再從另一邊往下降，形成對流。 2. 根據水受熱時的流動情形，水是如何傳播熱的呢? 水受熱時，由受熱的底部向上移動，上方溫度較低的水，會流向底部，不斷的循環上下流動。 Experimental operation ◆ Experiment equipment: sesame, water, beaker, alcohol column, tripod, Ceramic Centered Iron Wire Gauze ◆ Operating steps: 1. Put 30 ml hot water and a teaspoon of sesame into a 500ml beaker. Use alcohol column to heat up from the beaker's bottom. 2. Move alcohol column to left for a while and then to the right, observing sesame's move situation in the water. ◆ Points for attention: 1. You must put out the fire before you add more alcohol into the alcohol column. The biggest amount of alcohol column is 80% of alcohol. 2. If things ignite unfortunately, use the wet rag to put out the fire. 3. Use the cover and close alcohol column from one side when you put out the fire of it. ◆ Discussion: 1. How does sesame move in the water when it's heating up in the beaker? If the beaker is heating up from its middle bottom, sesame will raise and then fall from two sides which form the convection. If the beaker is heating up from one side of its bottom, sesame will raise and then fall from the other side which		中的例子。 Observe and discuss air convection through experiments, and tell examples in life.

	form the convection. 2. According to the flowing situation of the heating water, how does water spread the heat? When water is heating up, it raises from the bottom which is under heating. The water above with lower temperature will flow to bottom and keep the cycle of flow up and down 空氣的流動 air's flow 實驗操作 觀察冷、熱空氣的流動情形 ◆ 實驗器材： 廣口瓶、線香、公升盒、隔板、冰水、熱水、紅和藍圓點貼紙 ◆ 操作步驟： 1. 製造有煙的空氣瓶：將點燃的線香放入瓶內，使煙充滿瓶中 2. 製造冷空氣瓶(標藍點)：將有煙的瓶子用隔板蓋住瓶口再浸泡在冷水中 3. 製造熱空氣瓶(標紅點)：將有煙的瓶子用隔板蓋住瓶口再浸泡在熱水中 4. 將有煙的冷空氣瓶倒放在無菸的熱空氣瓶上，抽掉隔板，觀察煙的流動情形 ◆ 討論： 1. 實驗時，使線香的煙充滿瓶中的目的是什麼? 加了煙可以清楚看到冷空氣、熱空氣的變化 2. 有煙的冷空氣瓶倒放在無煙的熱空氣瓶上，煙會如何流動? 煙流向下方的熱空氣瓶中 3. 有煙的熱空氣瓶放在無煙的冷空氣瓶下方，煙如何移動? 煙往上方的冷空氣瓶飄 歸納：冷空氣會向下方流動；熱空氣則會向上方流動 空氣也會透過熱空氣上升，冷空氣下降的方式傳遞熱 Experiment: observe cold air and warm air's flow situation ◆ Experiment equipment: wide mouth bottle, incense, Liter box, partition, ice water, hot water, red and blue spot sticker ◆ Operating steps: 1. Make a gas bottle full of smoke: put the igniting incense into the wide mouth bottle to make bottle be full of smoke 2. Make a cold gas bottle: cover the mouth of the smoke bottle with the partition and soak it in cold water 3. Make a warm gas bottle: cover the mouth of the smoke bottle with the partition and soak it in hot water 4. Put the smoke cold gas bottle upside down on the nonsmoker warm gas bottle. Take away the partition and observe the smoke's flow situation.	15'	

◆ Discussion:

1. What is the purpose to make the bottle full of incense's smoke during the experiment?
   We can see the cold air and warm arm's changes clearly with smoke.
2. How does the smoke move when we put the smoked cold gas bottle upside down on the nonsmoking warm gas bottle?
   Smoke will flow down to the warm gas bottle.
3. How does the smoke move when we put the warm gas bottle under the nonsmoking cold gas bottle?
   Smoke will raise to the upper cola gas bottle.

【Explain 解釋】

5'

Conclusion:
Cold air will flow down and warm air will flow up.
Air could also spread heat from warm gas raise and cold gas fall.

✧ 日常生活中，我們常用到熱空氣上升，冷空氣下降的原理：例如將冷氣機放在高處，冷空氣吹出後可以往下流動
In daily life, we often use the theory of warm air raise and cold air fall.
For example: putting air conditioning at the high place can let the cold air be flow down

Heat Transfer: Conduction, Convection, and Radiation

https://www.youtube.com/watch?v=HpCvWuvCUoA

【Fifth class】

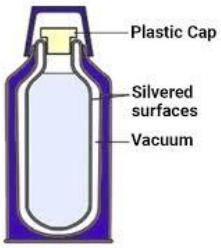
2-3 熱的輻射 Heat radiation

【Explain 解釋】

20'

✧ 太陽的熱是如何傳播的呢?
在太陽下會吸收到太陽的熱，因此太陽的熱是由太陽傳播到地球上的
→太陽的熱不靠任何物質傳遞即可傳播，這種傳熱方式稱為輻射
How does sun's heat been spread?
When we stay under the sunshine, we will absorb sun's heat. Because sun's heat was spread from sun to Earth.

	✧ 在陽光下曝曬一段時間的不同建築材料，它們受熱的情形會相同嗎? 建材不同，受熱情形也不同 在鐵皮建材的房屋裡感覺比較熱 在木造建材的房屋裡感覺比較涼快 Will different building materials have the same situations of receiving heat after being exposed to sunshine for a while? Different building materials have different situation of receiving heat. We feel hotter when we are in the galvanized iron sheet house. We feel cooler when we are in the wooden house. **Animation - Third Heat Flow : Radiation (Commerical)** https://www.youtube.com/watch?v=-sI2sDO9aeE **【Sixth class】** **2-4 保溫 heat preservation** **【Explain 解釋】** ✧ 利用物體對熱的傳播速度不同，使用不同的物品或方法來減少熱的傳播，達到保溫。 heat preservation: We can use different materials or ways to decrease heat spread by that materials has different heat spreading speed. **保溫杯 thermos cup**	10’ 20’	了解太陽的熱如何傳到地球進而認識熱輻射。 Understand how the sun’s heat is transferred to the earth and then understand the thermal radiation.

	  -杯蓋：減少熱對流 -內膽：表面光滑能減少熱輻射 -真空層：杯壁中間抽去空氣，形成真空層，可以減少熱的傳導和對流 -Cap: reduce heat convection -Silvered surface: smooth surface can reduce heat radiation -Vacuum flask: removing the air between the cases to make vacuum flask in order to reduce the heat conduction and convection. **保溫袋 thermos bag**： 裡面的鋁箔材料能減少熱輻射達到保溫效果 The aluminum foil material inside can reduce heat conduction to make heat preservation **羽絨外套 down jacket**： 羽絨縫隙間的空氣受熱膨脹後，將熱空氣保留在內使身體不覺得冷 The gaps between down will inflate after being warm. And it can keep the warm gas inside the jacket to keep us warm. Conduction, Convection, and Radiation [SONG!] https://www.youtube.com/watch?v=7Y3mfAGVn1c	10’	能說出各種材料的保溫效果不同。 Can tell the different insulation effects of various materials.

參考資料

Make a Convection Heat Powered Windmill - Fun Kids Science Experiments

https://www.youtube.com/watch?v=v2bYpjMDFVo