第七單元：水的性質	**Unit 7: Properties of Water**
主要觀念:	**Key Ideas:**
7.1 觀察，形容，和探索水的物理性質。	7.1 Observe, describe, and explore the physical properties of water.
7.2 探索不同的因素如何影響蒸發。	7.2 Explore how different factors affect evaporation.
7.3 形容水的循環。	7.3 Describe the Water Cycle.
7.4 測試物體來決定它們是否沉浮。	7.4 Test objects to determine whether they sink or float.
7.5 預測，觀察，和檢視不同的物質來決定它們和水相容的能力。	7.5 Predict, observe, and examine different substances to determine their ability to mix with water.
7.6 檢視和形容實體從一個狀態到另一個狀態的轉變。	7.6 Examine and describe the transformation of matter from one state to another.
7.7 預測和查證熱能對物體和材料所產生的效應。	7.7 Predict and investigate the effect of heat energy on objects and materials.
7.8 形容材料的物理改變。	7.8 Describe the physical changes of materials
單元大綱	**Unit Overview**
水是地球上最重要的物質。沒有水，將會沒有植物，沒有動物，沒有生命。人類的大腦大約有百分之八十是水，如果你流失你身體裏百分之十的水份，你將無法走路。流失百分之二十的水份，你的生命將會結束。 我們不斷的流失水份，我們就必須不斷的補充。雖然地球上有大量的水，但是百分之九十七的水是海洋，太鹹而無法飲用。至於清水，大部份是位於南北極冰層地帶。儘管如此，大部份的地方仍是充滿了以河川和湖的形式存在的水，地面上和地面下。當我們使用這些水的時候，水會被自然的過程而取代，是水的循環的一部份。	Water is the most important substance on Earth. Without it, there would be no plants, no animals, and no life. The human brain is approximately 85% water, and if you lost 10% of the water in your body you would not be able to walk. A loss of 20% would be fatal. As we are constantly losing water we need to take in more to replace it. Although there is a huge amount of water on Earth, 97% of it is in the oceans and far too salty to drink. Of the fresh water, most is frozen in the polar ice caps. Even so, there is plenty of water around (in most places anyway) in the form of rivers and lakes, both above and below ground. As we use this water, it is replaced by natural processes as part of the water cycle.

水有許多不尋常的性質，並且是一種特別的化合物，因爲許多的物質都可以在水裏溶解。	Water has many unusual properties and it is a special compound because many substances dissolve in it.

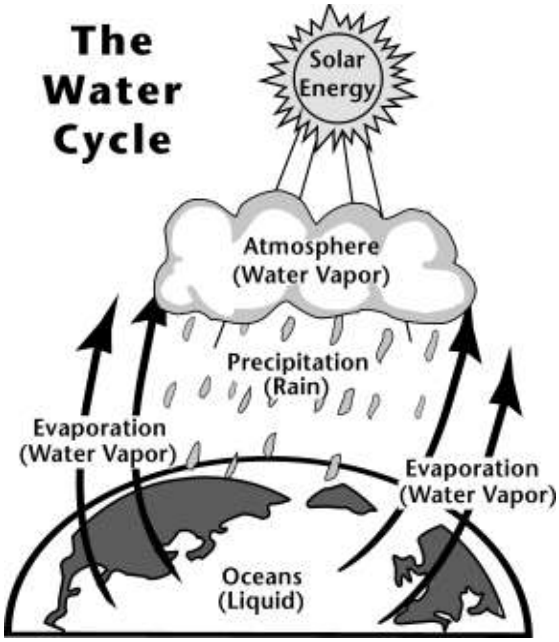
第七單元：水的性質	**Unit 7: Properties of Water**
關鍵問題: 什麼讓水如此特別?	**Essential Question:** What makes water so special?
7.1 主要觀念 觀察，形容，和探索水的物理性質。	**Key Idea 7.1:** Observe, describe, and explore the physical properties of water.
科學用語: 1. 實體 2. 實體的狀態 3. 固體 4. 液體 5. 氣體 6. 體積	**Scientific Terms:** 1. matter 2. state of matter 3. solid 4. liquid 5. gas 6. volume
內容: 圍繞在你周圍的每一樣東西都是**實體**。你的桌子，其他的人，空氣，飲水器的水都是不同種類的實體。實體有不同的形態，稱作狀態。我們可以觀察到的三種**實體的狀態**是**固體**，**液體**，和**氣體**。 當實體是固體的時候，它保持它的固定形狀。它的體積，空間可以容納的大小，保持不變。 當實體是液體的時候，它的形狀可以改變，但是體積保持不變。例如，我們可以把水裝在玻璃瓶子裏或塑料袋裏，來改變水的形狀。塑料袋裏裝的水來自玻璃瓶。水的體積是一樣的，但是形狀已經改變。 當實體是氣體的時候，它無法保持它的形狀或體積。空氣是由不同種類的氣體組合而成。 你把空氣灌入氣球裏，空氣便形成氣球的形狀。當你把空氣從氣球裏放掉，空氣中的氣體便在你四周散開，佔有更多的空間。	**Content:** Everything around you is **matter**. Your desk, other people, the air, and the water in the drinking fountain are all different kinds of matter. Matter has different forms, called states. The three **states of matter** we can observe are **solids**, **liquids**, and **gases**. When matter is solid, it holds its shape. Its volume, which is the space it fills, stays the same. When matter is a liquid, its shape can change, but its volume stays the same. For example, we can change the shape of water in a glass by pouring it into a plastic bag. The plastic bag holds the water from the glass. The water's volume is the same, but its shape has changed. When matter is a gas, it cannot hold its shape or its volume. Air is made up of different kinds of gases. After you put air in balloons, the air takes the shape of the balloon. When you let the air out of the balloon, the gases in the air spread out around you and take up more space.
複習: 1. 三種實體的狀態中，哪一種狀態無法保持形狀或體積? 2. 如果一個液態從一個高瓶子倒入一個扁盤子，它的形狀或體積改變了嗎? 3. 比較固體，液體，和氣體的特性。	**Review:** 1. Which of the three states of matter cannot hold shape or volume? 2. If a liquid is poured from a tall bottle into a shallow pan, does its shape or volume change? 3. Compare the properties of solids, liquids, and gases.

第七單元：水的性質	**Unit 7: Properties of Water**
關鍵問題: 什麼讓水如此特別?	**Essential Question:** What makes water so special?
7.2 主要觀念 探索不同的因素如何影響蒸發。	**Key Idea 7.2:** Explore how different factors affect evaporation.
科學用語: 1. 分子 2. 水蒸氣 3. 蒸發 4. 濕氣 5. 凝結	**Scientific Terms:** 1. molecule 2. water vapor 3. evaporation 4. humidity 5. condensation
內容: 水**分子**通常都是移動的。在水的表面，有些分子被下面的分子撞擊而有足夠的速度脫離，跑到空氣中成爲氣體（**水蒸氣**）. 這種表面分子脫離稱作**蒸發**。它牽涉到形態的改變，從液體到氣體。蒸發在任何時間，任何溫度下都會發生。越高的溫度，蒸發的速度就越快。當水的溫度增加（例如，用強力的聚光燈照射），水分子得到更多的能量，活動的更快，也以更快的速度脫離。	**Content:** Water **molecule**s are always moving. At the water's surface, some molecules are bumped by molecules below them and gain enough speed to break free and escape into the air as gas (**water vapor**). This escape of surface molecules is called **evaporation**. It involves a change of state, from liquid to gas. Evaporation takes place all the time and at any temperature. The higher the temperature, the higher the rate of evaporation. When the temperature of water is increased (e.g. shining a powerful spotlight on it), the water molecules gain more energy, move faster and escape at a faster rate.
當蒸發產生的時候，水蒸氣聚集在水的表面之上。當有風的時候，水蒸氣一形成就馬上被移走。這樣產生空間可以讓更多的水分子脫離到空中。越強的風，蒸發的速度就越快。	When evaporation takes place, the water vapor gathers above the water's surface. When it is windy, the water vapor is removed as soon as it is formed. This makes space for more water molecules to escape into the air. The stronger the wind, the higher the rate of evaporation.
裝在碗裏的水，它的表面範圍直接接觸空氣。這只是佔碗裏的水的體積的一小部份。如果水灑在桌上，幾乎所有的水都曝露在空氣裏。曝露的範圍越大，任何時候都有更多的熱和風可以和水分子接觸。因此，蒸發的速度比水在碗裏面要來得快。曝露的範圍越大，蒸發的速度越快。	The surface area of the water in a bowl is in direct contact with the air. This is only a small fraction of the total amount of water in the bowl. If the water is spilled onto the table, almost all of the water is exposed to the air. With a larger exposed area, more heat and wind can come into contact with the water molecules at any time. Therefore, the rate of evaporation is higher than that of the water in the bowl. The larger the exposed surface area, the higher the rate of evaporation.
如果水是在一個密閉的容器裏蒸發，水上方的空間會充滿越來越多的水蒸氣。當空氣中充滿了水蒸	If water evaporates in an air-tight container, the space above the water is filled with more and

氣，**濕氣**就會高。濕氣指的是空氣中水蒸氣的含量。當濕氣高的時候，水蒸發的就比較困難。就好像空氣中已經充滿了水蒸氣，已經不再如此飢渴。空氣“吃”得少，造成蒸發的速度變慢。如果水面以上的空間變成完全充滿了水蒸氣，蒸發便會被相反的過程，凝結，來均衡。	more water vapor. When the air contains a lot of water vapor, **humidity** is high. Humidity refers to the amount of water vapor in the air. When humidity is high, it is more difficult for water to evaporate. It is like the air is full and not hungry for more water vapor. Thus the air will “eat” less at one time, resulting in a slower rate of evaporation. If the space above the water becomes completely filled with water vapor, then evaporation is balanced by the opposite process, condensation.
複習： 1. 當你站在風扇旁邊，爲什麼你會覺得涼爽？ 2. 什麼因素影響蒸發的速度？ 3. 爲什麼我們應該把我們溼的衣物打開來曬乾? 4. 當我們想要水燒滾得更快，我們應該打開還是蓋上蓋子？爲什麼？	**Review:** 1. Why do you feel cool when you stand next to a fan? 2. What factors affect the rate of evaporation? 3. Why should we spread out our wet clothes to dry? 4. When we want to boil water faster, should we open or close the lid? Why?

第七單元：水的性質	**Unit 7: Properties of Water**
關鍵問題: 什麼讓水如此特別?	**Essential Question:** What makes water so special?
7.3 主要觀念 形容水的循環。	**Key Idea 7.3:** Describe the Water Cycle.
科學用語: 1. 降水 2. 水的循環 3. 蒸發 4. 水蒸氣 5. 凝結 6. 雨 7. 雪雨 8. 雪 9. 冰雹 10. 逕流 11. 地下水	**Scientific Terms:** 1 precipitation. 2. water cycle 3. evaporation 4. water vapor 5. condensation 6. rain 7. sleet 8. snow 9. hail 10. runoff 11. groundwater
內容: 如果地球上所有的水都保持在海洋裏，會發生什麼？土地將如何得到水來讓植物生長？土地上的動物喝什麼？幸運的是，水是到處移動的。 落到地球上的水(**降水**)不是新的水。這是經由地球和空氣不斷循環的同樣的水。由太陽的能量來產生的這個過程稱作**水的循環**。 水存在於三種狀態：氣體，液體，和固體。太陽將地球上的水加熱， 造成蒸發，將水轉變成看不見的**水蒸氣**。水蒸氣上升到地球的高空，溫度變低。在那裏，產生**凝結**。低溫將水蒸氣再轉變回液狀的細小水珠。這些細小的水珠形成雲。**雨**，**雪雨**，**雪**，和**冰雹**是不同形式的降水，它們從雲落到地球上。因爲風會將雲層和暴風雨四處移動，因此水會降落在和它蒸發時不同的地點。如果水蒸氣凝固，它落下來的是雪。 如果雨在落下來的途中凝固，它落下來的是雪雨。當雲層裏的雨或雪形成冰，它落下來的便是冰雹。 一旦水落到地球，它不會停留在一個地方。大部份的水從地上或水坑立刻蒸發。剩餘的水滲入地下形成**地下水**，或沿著地面形成**逕流**。逕流將水帶入河	**Content:** What would happen if all the water on Earth stayed in the oceans? How would the land get water to grow plants? What would land animals drink? Fortunately, water moves around. **Precipitation** that falls to Earth is not new water. The same water is constantly recycled through the Earth and the air. The Sun's energy powers what is called the **water cycle**. Water exists in three states: gas, liquid, and solid. The Sun heats liquid water on Earth, causing **evaporation**, turning it into invisible **water vapor**. Water vapor rises high above the Earth where temperatures are lower. There, **condensation** takes place. The lower temperatures turn the water vapor back into tiny drops of liquid water. These tiny drops form clouds. **Rain**, **sleet**, **snow**, and **hail** are different forms of precipitation and they fall to Earth from the clouds. Because wind moves clouds and storms around, the water often falls in a different place from where it evaporated. If the water vapor freezes, it falls as snow. If rain freezes on the way down, it falls as sleet. When pieces of ice form in the clouds from rain or snow, they fall as hail. Once water lands on Earth, it does not stay in one place. Much of it evaporates from the ground or puddles right away. The rest of the water soaks into the ground as **groundwater**, or runs along the

川，最終流入大海。地下水也會慢慢的往河川和海洋流動。	ground as **runoff**. Runoff carries water to rivers, which empty themselves into the oceans. Groundwater also moves slowly toward the rivers and oceans.
水在地底下，在河川裏，在湖裏，在海洋裏，和以冰的形態存儲一段時日。然後太陽的熱造成蒸發，循環又再次開始。	Water is stored for a time in the ground and in rivers, lakes, oceans, and as ice. Then the heat of the Sun causes it to evaporate, and the cycle starts again.
因爲水的循環，土地被水降臨而土地上的植物得以生長。水從一個地方流到另一個地方，如此人類和動物才可以從山泉，小溪，河川，和湖裏利用水。人類並且可以鑿井，利用地下水。	Because of the water cycle, the land is watered and plants can grow. Water moves from place to place, so people and animals can use water from springs, streams, river, and lakes. Humans can dig wells and use the groundwater too.
複習： 1. 地下水和逕流有何相同之處？ 2. 什麽造成水蒸氣的凝結？ 3. 雪和雪雨如何不同？ 4. 什麽造成水的蒸發？ 5. 如果任何時候都會發生蒸發，爲什麽海洋不會乾掉？ 6. 如果風不會移動空氣，雲層，和暴風雨，那將會發生什麽在地球上？	**Review:** 1. How are groundwater and runoff alike? 2. What causes condensation of water vapor? 3. How are snow and sleet different? 4. What causes evaporation of water? 5. If evaporation is happening all the time, why don't the oceans dry up? 6. What would happen to Earth's water if wind did not move air, clouds, and storms?



第七單元：水的性質	**Unit 7: Properties of Water**
關鍵問題: 什麼讓水如此特別？	**Essential Question:** What makes water so special?
7.4 主要觀念 測試物體來決定它們是否沉浮。	**Key Idea 7.4:** Test objects to determine whether they sink or float.
科學用語: 1. 漂浮　2. 下沉　3. 位移 4. 質量　5. 密度	**Scientific Terms:** 1. float　2. sink　3. displacement 4. mass　5. density
內容: 當一個物體**漂浮**的時候，它可以停留在液體的表面。不同的固體，液體，和氣體可以漂浮。例如，軟木塞和油都可以漂浮在水的表面。有些氣體，例如氦氣，可以上升，或“飄浮”在空中。當一個物體**下沉**的時候，它跟隨著地心引力往下移動。不同的固體，液體，和氣體會下沉。例如，一個硬幣會在一杯水裏往下沉。比空氣重的氣體，例如丙烷和丁烷，都會下沉。 **位移**解釋爲什麼物體下沉或漂浮。位移發生在當你放置一些東西在流體裏，或任何會流動的物質裏，它把流體推擠到旁邊。當你丟一個物體到一杯水裏，水的高度上升，你便看到移位產生。地心引力把物體往下拉，但是物體之上和物體之下的壓力不同，因此造成上升的力。物體把水往旁邊推擠，造成水位升高。如果一個物體的重量大過它推擠的水量，這個物體會下沉。如果一個物體的重量小過它推擠掉的水量，這個物體便會漂浮。 希臘數學家阿基米德(Archimedes)發現被物體移位的水量是根據那個物體的**質量**。質量是一個物體裏面材料的量。**密度**（體積除以質量）是在一定的實體體積裏含有多少質量。如果一個固體有比水大的密度，它就會在水裏下沉。如果一個固體有比水小的密度，它就會在水裏漂浮。大部份的人都會漂浮。因爲他們的密度比水的密度小一	**Content:** When an object **float**s, it can stay on the surface of a liquid by itself. Different solids, liquids, and gases can float. For example, both cork and oil will float on the surface of water. Some gases, such as helium, can rise, or “float” in the air. When an object **sink**s, it moves down with gravity. Different solids, liquids, and gases sink. For example, a solid coin will sink in a cup of water. Gases that are heavier than air, such as propane and butane, can sink as well. **Displacement** explains why objects sink or float. Displacement occurs when you place something in a fluid, or any substance that flows, and it moves the fluid out of its way. You can watch displacement at work when you drop an object in a cup of water and the water level rises. Gravity pulls the object down, but the difference in pressure above and below the object causes an upward force. The object pushes the water out of its way, making the water rise. An object will sink if it weighs more than the water it pushes away, and an object will float if it weighs less than the water it pushes away. The Greek mathematician Archimedes discovered that the amount of water displaced by an object depends on the **mass** of that object. Mass is the amount of material that an object has in it. **Density** (mass divided by volume) is how much mass is in a certain volume of matter. If a solid object has a greater density than water has, it will sink in water. If an object has a lower density than water has, it will float. Most people

點。 形狀也會幫助一個物體漂浮。一團黏土會下沉，但是用同樣份量的黏土做成獨木舟的形狀就可以漂浮，因爲它移位比較多的水。一個物體裏含有的空氣也可以幫助它漂浮。儘管船是由很重，很稠密的材料製成，它仍是可以漂浮，因爲在船體裏面有大量的空氣。空心的物體，例如乒乓球或空塑膠瓶，都比實心的物體漂浮的好。	can float. Their density is slightly less than the density of water. Shape can also help an object float. A ball of clay will sink, but a canoe shape made from the same amount of clay can float because it displaces more water. The amount of air inside of an object can also help it float. Boats can float despite the heavy and dense materials used to build them because of the large amount of air inside the hull. Hollow objects, such as table tennis balls or an empty plastic bottle, are able to float better than solid objects.
複習： 1. 我們如何決定物體是會下沉還是漂浮？ 2. 形容形狀如何幫助一個物體漂浮。 3. 解釋爲什麼有些很重的物體例如船會漂浮，相對而言很輕的物體例如硬幣反而會下沉。	**Review:** 1. How do we determine if objects sink or float? 2. Describe how shape helps an object float. 3. Explain why some heavy objects like boats float, while relatively lighter objects such as coins sink?

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關鍵問題: 什麼讓水如此特別?	**Essential Question:** What makes water so special?
7.5 主要觀念 預測，觀察，和檢視不同的物質來決定它們和水相容的能力。	**Key Idea 7.5:** Predict, observe, and examine different substances to determine their ability to mix with water.
科學用語: 1. 物質 2. 混合物 3. 分子 4. 溶解 5. 溶液 6. 懸浮液	**Scientific Terms:** 1. substance 2. mixture 3. molecule 4. dissolve 5. solution 6. suspension
內容: 葡萄和一些橘子，香蕉，和蘋果混合在水果沙拉裏。水果合在一起的滋味很好，但是每一片水果都還保有自己原有的味道。每一片水果可以很容易的被分別出來。它們並沒有混合在一起變成一個新的**物質**。 一個**混合物**是兩個或更多的物質放在一起，或混合在一起，但是可以很容易被分離出來。一個混合物裏的每一個物質保有它自己的性質。一個混合物可以有不同份量的各種實體。例如，你可以用任何種類的水果做一個水果沙拉。你也可以用任何數量的各種水果來做。 一個固體和液體可以做成一個混合物。將沙子攪拌到水裏就形成一個固體和液體的混合物。就像所有的混合物，沙子和水可以很容易的被分離出來。 如果我們在杯子裏混合砂糖和水，砂糖和水就形成一個混合物。然而，我們無法看到砂糖。砂糖的**分子溶解**, 或平均的擴散在液體裏。一個物質平均的擴散在另一個物質裏，便形成一個**溶液**。溶液裏的物質仍是可以容易的被分離。如果水份蒸發，砂糖就會遺留在杯子裏。 換句話說，一碗水果沙拉不是一個溶液。我們可以分辨出其中的成份。沙子不會溶解在水裏。相反的，它們沉到底下。沙子和水不是一個溶液。	**Content:** Grapes and pieces of orange, banana, and apple are mixed in a fruit salad. The fruits taste good together, but each piece of fruit keeps its own taste. The pieces of fruit can easily be separated. They do not join together to make a new **substance**. A **mixture** is two or more substances that are placed, or mixed, together but can be easily separated. Each substance in a mixture keeps its own properties. A mixture can have different amounts of each kind of matter. For example, you can make fruit salad with any kinds of fruit. You also can use any number of pieces of each kind of fruit. A solid and a liquid can make a mixture. Stirring sand into water makes a mixture of a solid and liquid. Like all mixtures, sand and water are easy to separate. If we mix sugar and water in a glass, sugar and water make a mixture. However, we cannot see the sugar. The **molecule**s of sugar **dissolve**, or spread evenly, in the liquid. One substance spreading evenly throughout another substance forms a **solution**. The substances in a solution can be separated easily. If the water evaporates, the sugar is left in the glass. On the other hand, a bowl of fruit salad is not a solution. We can always tell the ingredients apart. Sand doesn't dissolve in water. Instead the grains

一些混合物裏，成份不是平均的擴散出去。當這些混合物沉澱，有些成份會浮升到最上面，或沉到最底下。這種混合物稱作**懸浮液**。一點一點的油會懸浮在水上。醋和油是一種混合物用作沙拉調味醬。我們必須先搖晃才可以使用，不然，我們很可能只倒出油在我們的沙拉上。同樣的，我們必須先搖晃柳橙汁罐， 因爲果肉和果汁是分離的。	of sand fall to the bottom. Sand in water is not a solution. In some mixtures, the ingredients are not spread out evenly. When these mixtures sit, some of the ingredients rise to the top or sink to the bottom. This kind of mixture is called a **suspension**. Bits of oil are suspended in water. Vinegar and oil is a mixture that makes salad dressing. We must shake it; otherwise, we might have just oil on our salad. We must shake the orange container too, because the pulp settles at the bottom of the container.
複習： 1. 爲什麼比薩餅是一個混合物但不是一個溶液？ 2. 除了沙子以外，舉出兩樣不能溶解在水裏的東西。 3. 你如何分辨一個混合物是否是一個懸浮液？	**Review:** 1. Why is pizza a mixture but not a solution? 2. Name two things besides sand that are not soluble in water. 3. How can you tell whether a mixture is a suspension?

第七單元：水的性質	**Unit 7: Properties of Water**
關鍵問題: 什麼讓水如此特別?	**Essential Question:** What makes water so special?
7.6 主要觀念 檢視和形容實體從一個狀態到另一個狀態的轉變。	**Key Idea 7.6:** Examine and describe the transformation of matter from one state to another.
科學用語: 1. 降低　2. 增加　3. 蒸汽	**Scientific Terms:** 1. decrease　2. increase　3. steam
內容: 水是唯一的物質可以自然的存在於三種實體的狀態: • 當下雨的時候或從水龍頭流出來的時候，水是一種液體。 • 當下雪的時候或結冰的時候，水是一種固體。 • 當熱讓它變成空氣中看不見的水蒸氣時，水是一種氣體。 當水的溫度降低，水結成冰的時候，水變成一個固體。冰庫裏的水變成冰塊。當水被加溫，溫度升高，水變成氣體。火爐將鍋子裏的水加熱，水轉變成水蒸氣。 水蒸氣是一種看不見的氣體。你看到一鍋滾水上方的蒸汽，是水蒸氣移動到冷空氣裏而變成水滴。這個蒸汽就好像一朵小雲。當蒸汽蒸發，它就變成水蒸氣。當水蒸氣遇到冷的表面，例如一扇冷的窗戶，它變回液體。當我們洗一個熱水澡的時候，我們可以看到蒸汽，也可以看到水珠在鏡子上。那是因爲當水蒸氣蹤到冷面，鏡子的表面，它變回液態的水。太陽提供熱量將下雨過後的水坑變成水蒸氣。當水蒸氣上升到空中，它冷卻，變成液態的水珠，就是我們看到的雲層。	**Content:** Water is the only substance that exists naturally as all three states of matter: • Water is a liquid when it rains or flows from a faucet. • Water is a solid when it is snow or frozen ice. • Water is a gas when heat causes it to become invisible water vapor in the air. Water changes into a solid when the temperature of the water decreases and the water freezes into ice. Water in the freezer of a refrigerator turns to ice. Water changes into gas when the water is heated and the temperature increases. The burner on a stove heats water in a pan and the water turns into water vapor. Water vapor is an invisible gas. The steam you see above a pot of boiling water is water vapor moving into colder air and changing into water droplets. This steam is like a small cloud. When the steam evaporates, it changes into water vapor. When water vapor meets a cold surface, such as a cold window, it turns back into liquid water. When we are taking a hot shower, we can see the steam, but we also can see the water droplets on the mirror. Because when the water vapor touches the cold surface, the mirror, it changes into liquid water. The Sun provides the heat that changes rain puddles in to water vapor. When the water vapor rises in the air, it cools, and changes into liquid water droplets that you see as clouds.
複習: 1. 如果一滴水掉到一個熱爐上，可能會發生	**Review:** 1. What will most likely happen if a drop of

什麼？ 2. 如果把冰塊放到滾水裏，冰塊會有什麼樣的改變？ 3. 水蒸氣是一種看不見的氣體。那蒸汽是什麼？	liquid water falls on a hot stove? 2. What change will occur to ice cubes if they are placed into the boiling water? 3. Water vapor is an invisible gas. What is steam?

第七單元：水的性質	**Unit 7: Properties of Water**
關鍵問題: 什麼讓水如此特別？	**Essential Question:** What makes water so special?
7.7 主要觀念 預測和查證熱能對物體和材料所產生的效應。	**Key Idea 7.7:** Predict and investigate the effect of heat energy on objects and materials.
科學用語: 1. 釋放　2. 結合　3. 融化　4. 岩漿	**Scientific Terms:** 1. release　2. combine　3. molten　4. lava
内容: 熱可以由許多不同的方式釋放出來，例如，經由燃燒，摩擦，或兩種物質結合產生熱。 熱能加在物體和材料上可以改變物質的實體狀態。金屬，通常是一個固體，可以加熱後變成液體。一些首飾品是經由這種方法成形的。金屬加熱直到它成爲液體。然後倒入模型。當金屬冷卻以後，它又變回固體，並保有模型的形狀。 石頭是一個固體， 在地球表面深深的底下被加熱，然後融化的，液體的岩漿從火山口爆發出來。當岩漿在地球表面冷卻，它變回成一個固體。	**Content:** Heat can be released in many ways, for example, by burning, rubbing (friction), or combining one substance with another. Heat energy on objects and materials can change the substances' state of matter. Metal, which is usually a solid, can be heated to turn into a liquid. Some jewelry is formed this way. The metal is heated until it is a liquid. Then it is poured into a mold. When the metal cools and becomes a solid again, it holds the shape of the mold. Rock, which is a solid, might be heated deep below Earth's surface and then erupt from a volcano as molten, or liquid, lava. When the lava cools on Earth's surface, it changes back to a solid.
複習: 1. 如果固體的金屬被加熱到一個非常高的溫度，會有什麼樣的改變？ 2. 當融化的，或液態的石頭在地球表面冷卻，會發生什麼？	**Review:** 1. What change occurs if solid metal is heated to a very high temperature? 2. What happens when molten, or liquid, rock cools on Earth's surface?

第七單元：水的性質	**Unit 7: Properties of Water**
關鍵問題: 什麼讓水如此特別?	**Essential Question:** What makes water so special?
7.8 主要觀念 形容材料的物理改變。	**Key Idea 7.8:** Describe the physical changes of materials.
科學用語: 1. 融化 2. 凍結 3. 沸騰 4. 凝結 5. 物理的改變 6. 溶解	**Scientific Terms:** 1. melting 2. freezing 3. boiling 4. condensing 5. physical change 6. dissolve
內容: 地球上的每一個物質都可以以固體，液體，或氣體的形態存在。這些稱作三種實體的狀態。 一個狀態的改變是發生在當一個物質從一種狀態改變到另一種狀態。每一個狀態的改變有它自己的名稱。如果一個固體加足夠的熱，它逐漸會轉變成液體。這個稱作**融化**。如果一個液體冷卻足夠，它會轉變成固體。這個稱作**凍結**。如果一個液體加足夠的熱，它會轉變成氣體。這個稱作**沸騰**。如果一個氣體冷卻，它會轉變成液體。這個稱作**凝結**。 溶化的冰柱和燒滾的水有何共同點？它們都顯示狀態的改變。一張紙被切碎，另一張紙被剪開，木頭被鏈鋸鋸下來。它們都有一些共同點。紙和木頭都改變了，但是這些改變沒有一個是狀態的改變。它們顯示的全部都是物理的改變。一個**物理的改變**是改變之後不會產生新的物質。狀態的改變是物理改變的例子。切碎，剪開，鋸下來，也都是物理改變的例子。 你如何知道一個狀態的改變是一個物理的改變？我們知道冰，水，和蒸汽是同一樣東西不同的形式。如果冰轉變成水，或水轉變成蒸汽，沒有新的物質產生。因此，這種改變是物理的改變。	**Content:** Every substance on Earth can exist as a solid, as a liquid, or as a gas. These are called the three states of matter. A change of state occurs when a substance changes from one state to another. Each change of state has its own name. If a solid is heated enough, it will eventually turn into a liquid. This is called **melting**. If a liquid is cooled enough, it will turn into a solid. This is called **freezing**. If a liquid is heated enough, it will turn into a gas. This is called **boiling**. If a gas cools, it will turn into a liquid. This is called **condensing**. What do melting icicles and boiling water have in common? They both show changes of state. A sheet of paper is being shredded, another sheet of paper is being cut, and wood is being carved with a chain saw. They all have something in common. The paper and wood are being changed, but none of these changes is a change of state. All of them show physical changes. A **physical change** is a change that does not result in a new substance. Changes of state are examples of physical changes. So are shredding, cutting, and carving. How do you know that a change of state is a physical change? We know that ice, water and steam are all different forms of the same thing. If ice changes to water or water changes to steam, no new substance is made. So, that change is a physical change.

你在切碎一張紙以後，你得到什麼？你得到許多切碎的紙。而當你把一張紙剪成兩半， 你得到兩張小一點的紙。尺寸和形狀不同，但是它們仍然是紙。 鏈鋸製造出許許多多的木片。它們很小，但是它們仍然是木頭。因爲木頭並沒有改變成另一種物質。這種改變是物理的改變。 **溶解**是另一種物理的改變。砂糖溶解，或變成平均的混合，在一罐熱水裏。我們知道溶解是一種物理的改變，因爲我們可以讓罐子裏的水蒸發，這是另一個物理的改變。水份蒸發了以後，砂糖留在罐子裏。砂糖沒有改變成其他的物質。它仍然在那裏。	After you shred a sheet of paper, what do you get? You get shreds of paper. And when you cut a sheet of paper in two, you get two smaller pieces of paper. The size and shape are different, but they are all still paper. The chain saw makes lots and lots of wood chips. They're small, but they're still wood. Since wood is not being changed into another substance, the change is a physical change. **Dissolving** is another kind of physical change. The sugar dissolves in, or becomes evenly mixed into, the hot water in the jar. We know that dissolving is a physical change because we can let the water in the jar evaporate, which is another physical change. After the water evaporates, the sugar is left behind in the jar. The sugar doesn't change into another substance. It's still there.
複習： 1. 所有的物理改變都有什麼共同點？ 2. 一個玻璃杯掉到地上粉碎成上百個碎片。這是一種物理的改變嗎？爲什麼是或不是？ 3. 一個廚師把油加到醋裏，混合以後做成沙拉調味醬。這是一種物理的改變嗎？爲什麼是或不是？ 4. 如果你加熱一個物質，可能會發生什麼？	**Review:** 1. What do all physical changes have in common? 2. A glass falls to the floor and smashes into hundreds of tiny pieces. Is this a physical change? Why or why not? 3. A cook adds oil to vinegar and then mixes it to make salad dressing. Is this a physical change? Why or why not? 4. What might occur if you heat a substance?

解答

7. 1

1. 氣體無法保持它的形狀或體積。
2. 形狀已經改變但是體積不變。
3. 當實體是固體的時候，它的形狀和體積保持不變。當實體是液體的時候，它的形狀會隨著盛裝的容器而改變，但是體積不變。當實體是氣體的時候，它無法有固定的形狀和體積。

7. 2

1. 當你站在風扇旁邊，風移走你的皮膚上蒸發的汗珠。這樣產生空間可以讓更多的水分子脫離到空中。風把熱從你的皮膚趨走，讓你感覺涼爽。
2. 溫度，風，和曝露在空氣中的表面範圍。
3. 因爲越大的範圍曝露在空氣中，蒸發的速度越快。
4. 我們應該蓋上蓋子，因爲水在密閉的容器裏，水上方的空間會充滿越來越多的水蒸氣。當空氣中充滿了水蒸氣，**濕氣**就會高。當濕氣高，水蒸發的就比較困難。

7. 3

1. 它們以降水的方式掉落都是水的活動的名稱。兩者逐漸的都會移動到大的水域。
2. 比較冷的溫度
3. 雪是凍結的水蒸氣；雪雨是凍結的雨。
4. 一種溫度的上升

Answer Key

7.1

1. Gas cannot hold shape or volume.
2. The shape is changed but the volume stays the same.
3. When matter is solid, it holds its shape and volume. When matter is liquid, it holds its volume, but its shape will change according to the container that holds it. When matter is gas, it cannot hold its shape or volume.

7.2

1. When you stand next to a fan, the wind removes evaporation of sweat droplets on your skin. This makes space for more water molecules to escape into the air. The wind draws heat away from your skin and you feel cool.
2. Temperature, wind, and the amount of surface area exposed to air affect the rate of evaporation.
3. We should spread out our wet clothes to dry because the larger the exposed surface area, the higher the rate of evaporation.
4. When we want to boil water faster, we should close the lid. Because the water is in an air-tight container, the space above the water is filled with more and more water vapor. When the air contains a lot of water vapor, **humidity** is high. When humidity is high, it is more difficult for water to evaporate.

7.3

1. Groundwater and runoff both name movements of water after it falls as precipitation. Both eventually move to large bodies of water.
2. Cooler temperatures cause condensation of water vapor.

5. 因爲降水將水帶回到海洋。

6. 水會從海洋蒸發到空中，形成雲層，然後掉落回到海洋，土地沒有水份，會枯乾。

3. Snow is frozen water vapor; sleet is frozen rain.
4. A rise in temperature causes evaporation of water.
5. The oceans don't dry up because precipitation returns water to the oceans
6. If wind and air did not move air, clouds and storms, water would evaporate from oceans into the air, form clouds, and fall back into the ocean, leaving the lands dry.

7. 4

1. 我們必須測試物體來決定它是否可以漂浮或下沉。因爲一個物體可以漂浮或下沉是依賴它推擠出去的水和自己重量之間的關係。如果一個物體的重量大過它推擠的水量，這個物體會下沉。如果一個物體的重量小過它推擠掉的水量，這個物體便會漂浮
2. 當你改變形狀，你也同時改變物體的密度。如果你拿一個紙船放在水裏，它會漂浮，但是如果你把紙形成一個球，它變得壓縮，它就會下沉。那是因爲它的重量大於被移位的水的重量。

3. 依照它們的密度（體積除以質量）。如果這個物體的密度高於水的密度，這個物體會下沉。如果這個物體的密度低於水的密度，這個物體會漂浮。

7.4

1. We have to test the object to determine if it can sink or float. Because an object can sink or float depends on the water it pushes away and the weight of itself. An object will sink if it weighs more than the water it pushes away, and an object will float if it weighs less than the water it pushes away.
2. When you change the shape you are also changing the density of the object. If you take a paper boat and put it into water it will float, but if you shape the paper into a ball it becomes compact and will sink. That is because its weight is more than what the displaced water weighs.
3. It depends on their density (mass divided by volume). If the object's density is higher than the density of water, that object sinks. If it's lower, that object will float.

7. 5

1. 比薩餅是一個混合物，因爲我們可以很容易的分離它的成份。它不是一個溶液因爲它的物質沒有平均的擴散在另一個物質。
2. （建議的答案）油，油漆，粉筆，蠟，磚頭，玻璃，等等。
3. 當這個混合物沉澱，如果有些成份上升到表面或下沉到底部，這個混合物是一個懸浮液。

7.5

1. Pizza is a mixture，because we can easily separate its ingredients. It is not a solution because its substance doesn't spread evenly throughout another substance.
2. (Suggested answers): oil, paint, chalk, crayons, brick, glass, etc.
3. When the mixture sits, if some of the ingredients rise to the top or sink to the bottom, this mixture is a suspension.

7. 6 1. 水滴會馬上蒸發成水蒸氣。 2. 冰塊會不見並轉變成液體。 3. 蒸汽是水蒸氣混合冷空氣。 7. 7 1. 金屬會從固體轉變成液體。 2. 融化的，或液態的石頭會轉變回固體。 7. 8 1. 所有物理的改變都不會產生新的物質。 2. 這是一個物理的改變。因爲就算它破碎成百片，它仍然是玻璃。 3. 這是一個物理的改變。因爲我們仍然可以很容易的分離油和醋。這個混合物並沒有產生新的物質。 4. 如果你加熱一個物質, 這個物質可能會改變成液體或氣體。	**7.6** 1. The drop of liquid water would evaporate right away and become water vapor. 2. The ice cubes will disappear and change into liquid. 3. Steam is water vapor mixed with cold air. **7.7** 1. The metal will change from solid to liquid. 2. The molten, or liquid rock, will change back to a solid. **7.8** 1. All physical changes do not result in a new substance. 2. This is a physical change because even if the glass smashes into hundreds of tiny pieces, the pieces are still glass. 3. This is a physical change because we still can easily separate the oil from the vinegar. The mixture doesn't create a new substance. 4. If you heat a substance, the substance might change into liquid or gas.