


第三單元：簡單機械	Unit 3: Simple Machines
<p>主要觀念：</p> <p>3.1 示範機械能如何經由力的運用或利用簡單機械，在移動中造成改變。</p> <p>3.2 觀察和形容一個物體在移動中受摩擦的影響而產生的改變。</p> <p>3.3 觀察和形容一個物體移動的位置或方向如何被推力和拉力而改變。</p> <p>3.4 觀察地心引力如何將物體拉向地球的中心。</p>	<p>Key Ideas:</p> <p>3.1 Demonstrate how mechanical energy may cause change in motion through the application of force or the use of simple machines.</p> <p>3.2 Observe and describe how the amount of change in the motion of an object is affected by friction.</p> <p>3.3 Observe and describe how the position or direction of motion of an object can be changed by pushing or pulling.</p> <p>3.4 Observe how the force of gravity pulls objects toward the center of the Earth.</p>
單元大綱	Unit Overview
<p>我們使用的是什麼樣的機械？我們可能不會想到一個削鉛筆機，一輛腳踏車，或一個榔頭是一種機械，但是它們全部都是機械。一個機械是可以讓工作更容易的任何工具。</p> <p>當我們騎一輛腳踏車，腳部的肌肉提供讓腳踏車快速移動的能量。由簡單機械組合而成的腳踏車，讓騎腳踏車的人用最少的能量而達到最大的功。</p> <p>簡單機械就在我們的四周：學校，家裏，和社區。它們改變一個力的力度，方向，或速度來讓工作更容易。</p>	<p>What kinds of machine do we use? We may not think of a pencil sharpener, a bike, or a hammer as a machine, but they are. A machine is any tool that makes work easier to do.</p> <p>When we ride a bike, the muscles in the rider's legs provide the energy to move the bike quickly. The simple machines that make up the bike let the rider do the most work while using the least energy.</p> <p>Simple machines are all around us: in school, at home, and in the community. They make work easier by changing the strength, direction, or speed of a force.</p>

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3.1 主要觀念 示範機械能如何經由力的運用或利用簡單機械，在移動中造成改變。	Key Idea 3.1 Demonstrate how mechanical energy may cause change in motion through the application of force or the use of simple machines.
科學用語： 1. 力 2. 功 3. 斜面 4. 坡道 5. 楔形物 6. 螺旋 7. 杠杆 8. 支點 9. 棒 10. 輪子 11. 軸 12. 滑輪（組）	Scientific Terms: 1. force 2. work 3. inclined plane 4. ramp 5. wedge 6. screw 7. lever 8. fulcrum 9. rod 10. wheel 11. axel 12. pulley
內容： 由一個或兩個部位構成的工具稱作簡單機械。簡單機械利用機械能來改變一個力的力度，方向，或速度。如果我們使用簡單機械，功，例如起重，裁剪，撬開，鑽緊，和移動物體，會比較容易。 斜面 一個平板是一個面。當這個板，或面，是斜的，它可以幫助我們移動物體穿過一段距離。坡道是最常見的斜面。如果我們利用坡道滑上或滑下一個很重的盒子，移動這個盒子將會比較容易。  楔形物 當你用一個斜面的尖的邊緣來將東西推開，這個斜面便是一個楔形物。一個鑿子，用來將一片木頭剖開，便是一個楔形物。斧頭，釘子，和刀都是楔形物。	Content: Tools with only one or two parts are known as simple machines. Simple machines use mechanical energy to change the strength, direction, or speed of a force . Work , such as lifting, cutting, prying, tightening, and moving objects, is easier when we use simple machines. Inclined Plane A smooth board is a plane. When the board, or plane, is slanted, it can help us move objects across distances. A ramp is a common inclined plane. Moving a heavy box is easier if we slide the box up or down a ramp. Wedge When you use the pointed edges of an inclined plane to push things apart, the inclined plane is a wedge. A chisel, when used to split a piece of wood, is a wedge. An axe, a nail, and knife are wedges, too.



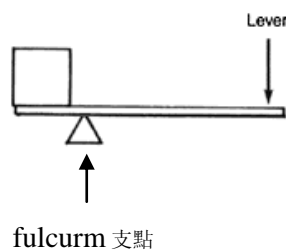
螺旋

一個螺絲釘是一個簡單機械，能把東西固定在一起。許多罐子都有一個大的，扁形的螺旋體把蓋子和罐子固定在一起。人們也利用螺絲釘把木頭或金屬片固定在一起。一個螺旋體實際上是一個圍繞著一個棒子的斜面。每一個螺旋都幫助東西固定在一起。



杠杆

一個把東西撬開或像手臂一樣舉起的工具叫做杠杆。如果我們想用一個螺絲起子把油漆桶的蓋子撬開，我們把螺絲起子的一端放到蓋子的底下。螺絲起子被支撐在油漆桶的邊緣，或是**支點**。然後，我們在螺絲起子的另一端往下壓。支點改變力的方向，造成螺絲起子在蓋子的另一端往上推。一個鏟子或遊樂園裏的蹺蹺板都是杠杆的例子。



輪軸

另一種簡單機械是輪軸。輪子轉動軸，造成移動。例如手推車，底下的輪子在軸上轉動，手推車便移動。門把是另一個例子。把手是輪子。軸是穿越門的棒子。軸連接內外兩個把手。當我們轉動門把，我們轉動軸。軸然後再移動門把的另外一部份，讓門打開。

Screw

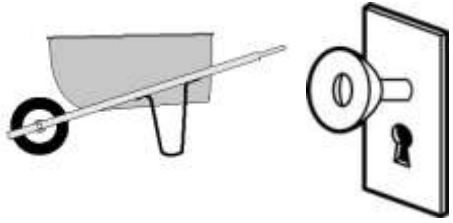
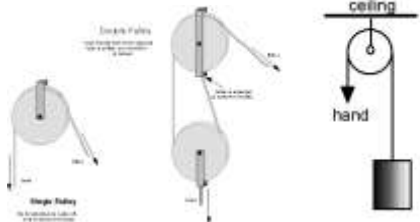
A screw is a simple machine that holds things together. Many jar lids have a large, flat screw that holds the lid to the jar. People also use screws to hold wood or metal pieces together. A screw is really an inclined plane wrapped around a rod. Every turn of a screw helps hold things together.

Lever

A tool that pries something loose or that lifts with an arm-like motion is a lever. If we use a screwdriver to pry open the lid of a paint can, we place one end of the screwdriver under the lid of the can. The screwdriver is held up by the edge of the can—or **fulcrum**. Then, we push down on the other end of the screwdriver. The fulcrum changes the direction of the force, causing the other end of the screwdriver to push up on the lid. A shovel or a playground seesaw can be another example of lever.

Wheel and Axle

Another kind of simple machine is the wheel and axle. The wheel turns the axle, which causes movement. An example of the wheel and axle is the wheelbarrow. The wheel below rotates on the axle and the wheelbarrow moves. A doorknob is another example. The knob is the wheel. The axle is the rod that goes through the door. The

 <p>滑輪（組）</p> <p>輪子也可以轉動繩子。這就是一個滑輪。一個滑輪，一根繩子包圍著一個輪子。當這個輪子轉動，繩子跟著移動。這個繩子可以用來拉高或降低物體。例如，旗杆上的旗子可以藉著滑輪升高或降低。有時候，幾個滑輪組合在一起用來移動物體。人類用滑輪組來搬動重型的物體，例如船，鋼琴，和保險箱。用越多的繩子來拉住裝載物，施加在裝載物上的力就越強。</p> 	<p>axle connects the two knobs. When we turn a doorknob, we turn the axle. The axle then moves another part within the doorknob that makes the door open.</p> <p>Pulley</p> <p>The wheel can also rotate a rope. This is a pulley. In a pulley, a rope wraps around a wheel. As the wheel rotates, the rope will move. The rope can be used to raise and lower objects. For example, a flag on a flagpole is raised and lowered by a pulley. Sometimes a number of pulleys are used to move objects. People use groups of pulleys to move heavy loads, such as boats, pianos, and safes. The more ropes used to hold the load, the stronger the force acting on the load.</p>
<p>複習：</p> <ol style="list-style-type: none"> 1. 什麼是簡單機械？ 2. 哪一種簡單機械有一個支點？ 3. 人們如何利用滑輪來工作？ 4. 當你把你手掌心的球舉起來，你像用一個杠杆一般的在用你的手臂。哪裏是個支點？ 5. 哪三種簡單機械是根據斜面原理？ 	<p>Review:</p> <ol style="list-style-type: none"> 1. What are simple machines? 2. Which simple machine has a fulcrum? 3. How do people use pulleys to do work? 4. When you lift a ball in the palm of your hand, you use your arm as a lever. What is the fulcrum? 5. Which three simple machines are based on inclined planes?

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3.2 主要觀念 觀察和形容一個物體在移動中受摩擦的影響而產生的改變。	Key Idea 3.2 Observe and describe how the amount of change in the motion of an object is affected by friction.
科學用語： 1. 摩擦力 2. 力 3. 摩擦 4. 平滑的 5. 粗糙的 6. 表面	Scientific Terms: 1. friction 2. force 3. rub 4. smooth 5. rough 6. surface
內容： 摩擦力 是一種讓移動中的物體慢下來或停止的力量。當一個物體和另一個物體 摩擦 ，就會產生摩擦力。 平滑 面之間的摩擦力比 粗糙 面之間的摩擦力小。 拿一片鋁箔和木頭摩擦，並不會產生多少的摩擦力。拿一片砂紙和木頭摩擦，就會產生摩擦力。當你拿著一片砂紙在木頭上來來回回的摩擦著，你會感覺到砂紙和木頭有微熱的現象。物體表面互相摩擦，表面的粗糙度會緩慢動作並產生熱。手推車的輪子讓你更容易的拉動它。那是因為，輪軸這種簡單機械會降低摩擦力並減少需要移動手推車所使用的力。 摩擦力幫助你每一天的工作。例如，你的鞋子和道路之間的摩擦力幫助你走路。如果沒有摩擦力，你可能很容易滑倒和摔倒。摩擦力讓你停止。摩擦力幫助輪胎在路上不會打滑。	Content: Friction is a force that slows down or stops moving objects. When an object rubs against another object, friction results. The friction between smooth surfaces is less than the friction between rough surfaces . Rubbing a piece of foil over wood does not cause much friction. Rubbing a piece of sandpaper over wood does cause friction. When you rub a piece of sandpaper back and forth across a piece of wood, the sandpaper and wood will feel warm when you touch them. The surfaces rub against each other; the roughness of the surfaces slows the movement and produce heat. The wheels on your wheelbarrow make it easier to pull. That’s because the simple machine of wheels and axles reduces friction and reduces the amount of force needed to move the wheelbarrow. Friction helps you do things every day. The friction between your shoes and the sidewalk helps you walk. Without friction, you would slip and fall. Friction makes you stop. Friction helps keep tires from slipping on the road.
複習： 1. 什麼造成摩擦力？ 2. 摩擦力如何改變一個物體的動力？ 3. 你如何降低在兩樣物體之間互相摩擦的摩擦力？	Review: 1. What causes friction? 2. How does friction change an object’s motion? 3. How can you reduce the friction between two objects rubbing together?

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科學用語： 1. 推 2. 拉	Scientific Terms: 1. push 2. pull
<p>內容： 想像你有一個空的小貨車，你想要將它移動一小段距離。你也許要推或拉它。不論推或拉，你都要用力來移動這個小貨車。力就是推或拉。例如小貨車這個物體，只有在某些東西推它或拉它，它才會開始移動。</p> <p>如果你只給這個貨車一點點地推力，它大概只會移動一點點。如果你和其他三個朋友一起用力推，這個貨車可能會移動的很遠距離。那是因為用力的多寡決定物體移動的距離。如果你在這個貨車裏裝滿了磚頭，你的貨車將會比較重，而你也需要用更多的力來移動它。</p> <p>推一個貨車上坡比推它下坡，需要更多的力。山坡就好像一個斜面的簡單機械，它會改變物體的動作。同時，我們必需用更多的力來抗拒地心引力把貨車拉往地球。</p>	<p>Content: Imagine you have an empty wagon that you want to move a short distance. You might push the wagon or you might pull it. Either way, you would use force to move the wagon. A force is a push or a pull. An object, such as the wagon, starts to move only when something pushes it or pulls on it.</p> <p>If you give the wagon just a little push, it would most likely move only a little bit. If you and three friends give it a big push, the wagon would travel further. That is because the amount of force used determines how far the object moves. If you filled the wagon with bricks, your wagon would be heavier and you would need more force to move it.</p> <p>Pushing a wagon uphill would take more force than pushing the wagon downhill. The hill acts like a simple machine called an inclined plane, which changes the motion of the object. At the same time, we have to use more force against the gravity that pulls the wagon back to Earth.</p>
<p>複習：</p> <ol style="list-style-type: none"> 1. 如果你推或拉一個小物體，會發生什麼？ 2. 在冰上，推一個載了兩個人雪橇比推載了一個人雪橇需要更多或更少的力？解釋為什麼。 	<p>Review:</p> <ol style="list-style-type: none"> 1. What will happen if you push or pull a small object? 2. Explain whether it will take more or less force to push a sled over ice with two persons than one person on it.

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科學用語： 1. 地心引力 2. 軌道	Scientific Terms: 1. gravity 2. orbit
<p>內容： 如果你把東西往空中丟，為什麼它們都會掉下來？答案是地心引力。在十七世紀的時候，牛頓就有個疑問為什麼月亮會繞著地球轉。他也好奇為什麼蘋果會從蘋果樹掉下來。牛頓後來發現到的這個力就稱作地心引力。地心引力是在兩個物體之間互相吸引的力。它把蘋果拉向地球，它也讓月亮在軌道上繞著地球轉。</p> <p>月亮也有地心引力。因為月亮比地球小，它的地心引力也比地球小。因此，月亮不會像蘋果一樣掉到地球上。如果沒有地心引力，月亮的移動路徑將會是遠離地球的一條直線。但是，月亮和地球的地心引力互相拉鋸，因而形成月亮圍繞著地球的一個圓弧型軌道。</p> <p>地心引力可以穿過氣體，液體，和固體。空氣保持在地球的周圍是因為地心引力。海水不會飛往太空是因為地心引力。石頭和土壤保持在地球上也是因為地心引力。你保持在地球上也是因為地心引力。如果你往上跳，地心引力會把你往地上拉下來。騎腳踏車上坡比下坡需要更多的力，因為地心引力不停的把你和腳踏車往下拉。沒有地心引力的話，氣體，液體，和固體都不會被拉向地球。它們可能都會飄浮在空中。</p>	<p>Content: Why do things come back down if you throw them up in the air? The answer is gravity. In the 17th century, Isaac Newton wondered why the Moon orbits the Earth. He also wondered why apples fall from apple trees. What Newton discovered was the force called gravity. Gravity is a force of attraction between objects. It pulls apples toward the center of the Earth and it also keeps the Moon in orbit around the Earth.</p> <p>The Moon has gravity too. Because the Moon is smaller than the Earth, its gravity is less than Earth's. Therefore, the Moon doesn't fall to Earth like an apple. If there were no gravity, the motion of the Moon would be a straight path away from the Earth. The pull of gravity of both the Earth and the Moon causes the path of the Moon to curve in an orbit around Earth.</p> <p>Gravity works through gases, liquids, and solids. Air stays around the Earth because of gravity. Oceans do not fly off into space because of gravity. Rocks and soil stay on Earth because of gravity. You stay on Earth because of gravity too. If you jump up, the gravity will pull you down to the ground. Riding a bicycle uphill would take more force than riding downhill because the gravity keeps pulling you and your bicycle down. Without gravity, gases, liquids, and solids would not be pulled to the center of Earth. They all would probably be floating in the air.</p>
複習： 1. 什麼是地心引力？	Review: 1. What is gravity?

<p>2. 如果沒有地心引力，月亮的移動將會如何不同？</p> <p>3. 如果地球沒有地心引力會發生什麼狀況？</p>	<p>2. How would the motion of the Moon be different if there were no gravity?</p> <p>3. What would happen if there were no gravity on Earth?</p>
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解答	Answer Key
<p>3.1</p> <ol style="list-style-type: none"> 1. 簡單機械是有很少或沒有活動的零件的工具，讓工作更容易。 2. 杠杆有支點。 3. 人類用滑輪（組）來移動物體往上，往下，或往旁邊。 4. 手肘是支點。 5. 楔形物，斜面，和螺旋。 	<p>3.1</p> <ol style="list-style-type: none"> 1. Simple machines are tools with few or no moving parts that make work easier. 2. The lever has a fulcrum. 3. People use pulleys to move objects up, down or sideways. 4. The elbow is the fulcrum. 5. Wedges, inclined planes, and screws are three simple machines based on the inclined plane.
<p>3.2</p> <ol style="list-style-type: none"> 1. 摩擦兩個物體。 2. 表面的粗糙度會緩慢物體的行動。 3. 在物體上加輪子。輪子會讓我們更容易拉。那是因為輪軸這種簡單機械會降低摩擦力，減低移動物體所需要的力。 	<p>3.2</p> <ol style="list-style-type: none"> 1. Rubbing two objects against one another causes friction. 2. The roughness of the surfaces slows down the movement of the object. 3. Add wheels to the object. Wheels will make it easier to pull. That's because the simple machine of wheels and axles reduces friction and reduces the amount of force needed to move the object.
<p>3.3</p> <ol style="list-style-type: none"> 1. 物體會移動。 2. 兩個人會增加雪橇的重量。移動一個比較重的物體需要比較大的力。 	<p>3.3</p> <ol style="list-style-type: none"> 1. The object will move. 2. Adding another person to the sled makes it weigh more. It will take more force to move a heavier object.
<p>3.4</p> <ol style="list-style-type: none"> 1. 地心引力是在兩個物體之間的吸引力。 2. 它的運行路徑將會是一條直綫，而不是圍繞著地球的圓弧路徑。 3. 所有的東西將會飄浮在空中。 	<p>3.4</p> <ol style="list-style-type: none"> 1. Gravity is the force of attraction between two objects. 2. Its path would be a straight line away from the Earth instead of a curved path around Earth. 3. Everything would float up in the air.