

## Teaching Unit : Inquiry and practice of Mendocino Motor

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### (一) Teaching Procedure

Period 1: Understanding the Mendocino Motor and Solar Cells			
Activities Description	1. Understand the differences in structure between various motors and the Mendocino motor. Recognize the function of each component inside a motor. 2. Guide students to learn how to operate a multimeter and measure simple circuits. 3. Understand solar cells, connect solar cells to a multimeter, and measure the relationship between voltage and current changes caused by light sources at different angles.	Time	One period (50 mins).
Teaching Activities	Content (with time)	Evaluation	
<b>Understanding Motors (Electric Motors)</b>	1. The teacher introduces the structure and operation of various motors (electric motors) through slides and introduces the Mendocino motor (this part helps students understand the basic conditions for driving electric motors) (10min).	In-class Q&A	
<b>Understanding solar cells (solar panels)</b>	The teacher introduces the basic semiconductor structure and operation of various solar cells (solar panels) through slides (this part helps students understand the basic principles of solar power generation) (10min).	In-class Q&A	
<b>Understanding multimeters</b>	Learn to use a multimeter to measure current, voltage, and resistance values in simple circuits (10min).	Notes/ Records on Science notebook	
<b>Measuring the efficiency of solar cells</b>	1. Connect the solar cell to the multimeter, and illuminate it directly from a fixed distance (as the maximum value). 2. Adjust the angle of the solar cell plane, measure and record the voltage and current values at both poles (20min).	Notes/ Records on Science notebook	

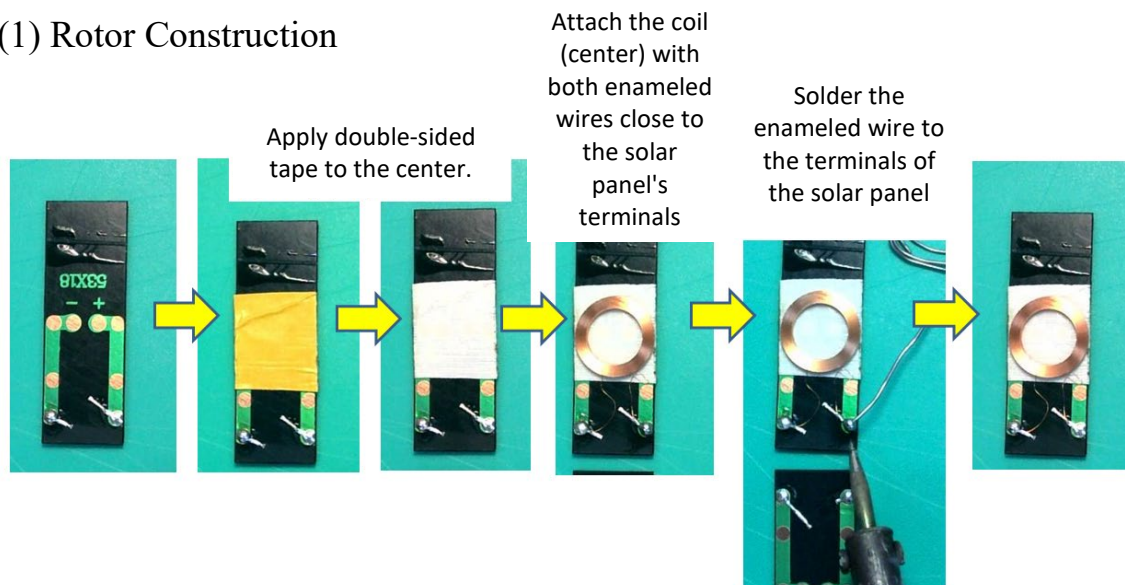
Period 2: Rotor coil current and magnetic field			
Activities Description	<ol style="list-style-type: none"> <li>1. Understand the magnetic effect of current and factors affecting the magnetic field of a circular conductor. Introduce the working principle of electromagnets.</li> <li>2. Guide students to practice basic soldering with a soldering iron and use wire strippers to cut wires.</li> <li>3. Connect the solar cell to the coil and observe the relationship between the magnetic field of the coil and the light source illuminating from different angles using a magnetic needle.</li> <li>4. Record the angle of light illumination and the deflection angle of the magnetic needle, complete the relationship graph, and each group reports based on the experimental results and previous analysis.</li> <li>5. Review simple circuit concepts (or strengthen them), explain the wiring connection of the Mendocino motor rotor, and let each group draw a basic circuit diagram of the solar cell and coil.</li> </ol>	Time	One period (50 mins).
Teaching Activities	Content (with time)		Evaluation
<b>Understanding the Magnetic Effect of Current and Electromagnets</b>	The teacher introduces the physical principles of the magnetic effect of current and various influencing factors through slides and introduces the magnetic field of current-carrying conductors and common applications (10min).		In-class Q&A
<b>Understanding basic tools</b>	<ol style="list-style-type: none"> <li>1. Use wire strippers to remove the insulation layer from the wires, completing two short wires with both ends stripped (length about 26mm).</li> <li>2. Practice cleaning the soldering iron and tinning the soldering points (10min).</li> </ol>		End-product Practice
<b>Relationship between solar cells and circular coil magnetic fields</b>	Use solar cells to supply current to the coil, illuminate the solar cells from different angles, and observe the magnetic field changes of the coil with a magnetic needle. Record the deflection angle of the magnetic needle and the illumination angle of the solar cell (20min).		Notes/ Records on Science notebook
<b>Simple circuits</b>	Given the condensed curriculum on circuit analysis at the junior high level, students may be unfamiliar with basic circuit analysis. The teacher first explains basic circuit analysis and related terms and the method for drawing circuit diagrams (10min).		In-class Q&A
<b>Homework</b>	<ol style="list-style-type: none"> <li>1. Process experimental values through EXCEL, complete the aforementioned relationship graph, compare and analyze the data from the previous solar cell power generation relationship, and report.</li> <li>2. Draw the basic circuit diagram of the Mendocino motor rotor and label the current relationship during operation.</li> </ol>		Notes/ Records on Science notebook

Period 3: Principle applications and practice			
Activities Description	<ol style="list-style-type: none"> <li>1. Guide students to assemble the Mendocino motor rotor through soldering.</li> <li>2. Guide students to use a scroll saw to cut wooden strips and assemble the Mendocino motor bracket.</li> <li>3. Adjust according to each group's progress to ensure the Mendocino motor rotates stably after illumination.</li> <li>4. Discuss the engineering structure that causes the continuous rotation of the Mendocino motor and test and discuss the variables of single/double-sided illumination.</li> </ol>	Time	Two periods (100 mins).
Teaching Activities	Argumentation, Modeling, Presentation and Sharing		Evaluation
<b>Making the Mendocino Motor Rotor</b>	Guide students to solder and assemble the Mendocino motor rotor (20min).		End-production Making
<b>Assembling the Mendocino Motor Bracket</b>	Guide students to use a scroll saw to cut wooden strips, measure and design the appearance length, glue strong magnets and wooden strips, and assemble the Mendocino motor bracket (20min).		End-production Making
<b>Planning and Research</b>	<p>Based on the learning content of the previous two classes, students carry out the following activities (10min):</p> <ol style="list-style-type: none"> <li>1. Develop a research plan: According to the proposed research questions on the Mendocino motor, plan appropriate methods, materials, equipment, and procedures.</li> <li>2. Collect data: Use tools to measure and design appropriate recording formats and record them accurately. Systematically collect qualitative or quantitative data or optimal conditions.</li> </ol>		Notes/ Records on Science notebook
<b>Expression and Sharing</b>	Each group presents their end-product in a presentation (50min).		Peer Evaluation Form

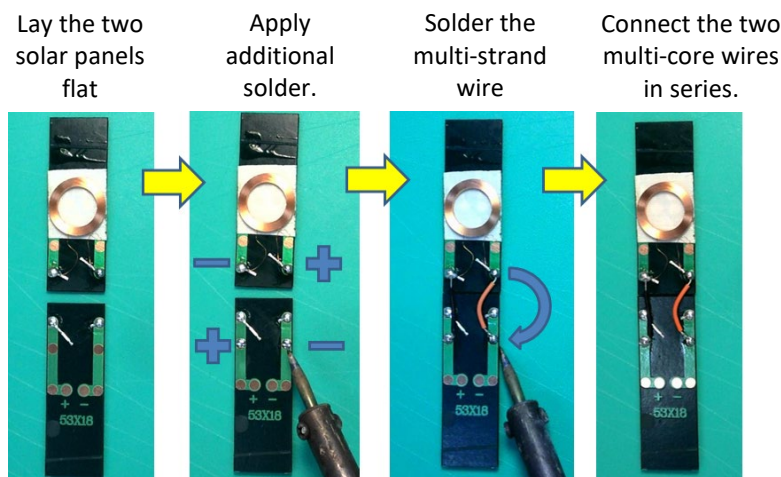
### Period 3 :

Follow the steps below to create a Mendocino motor. Please write down your personal thoughts on each step and take photos to document the process.

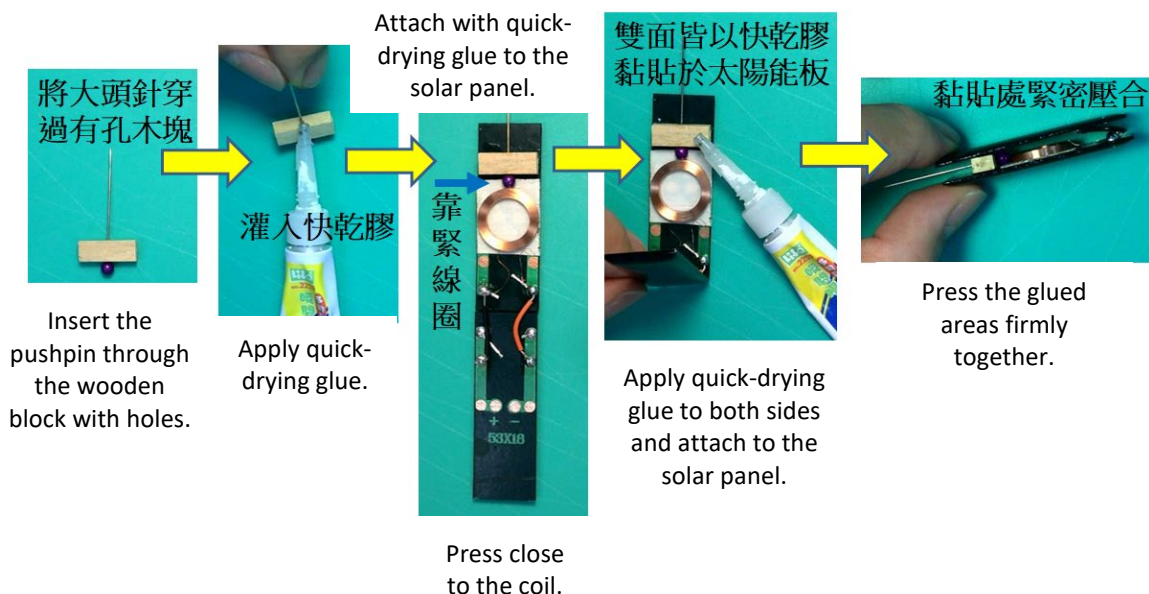
#### (1) Rotor Construction



Picture 4. Solder the coil to the solar panel.

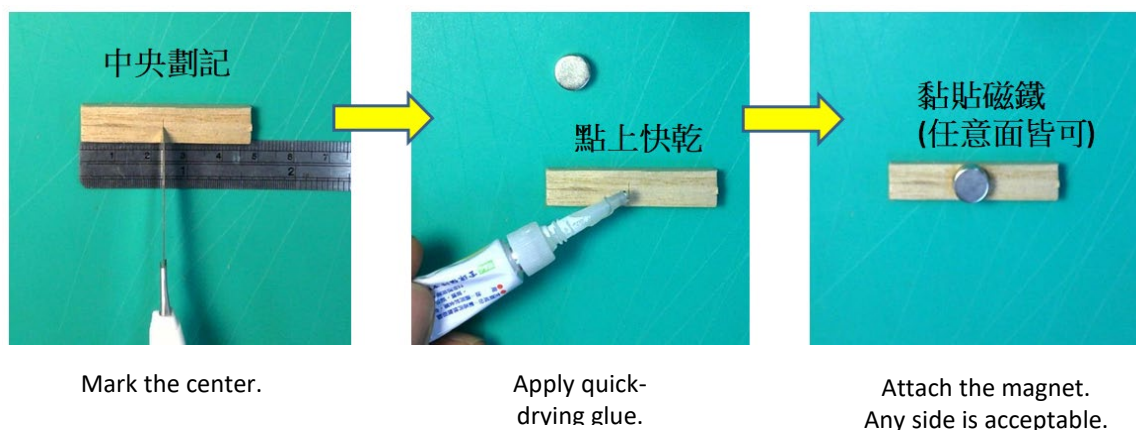


Picture 5. Connect the two solar panels with a wire (pay attention to the connection points).

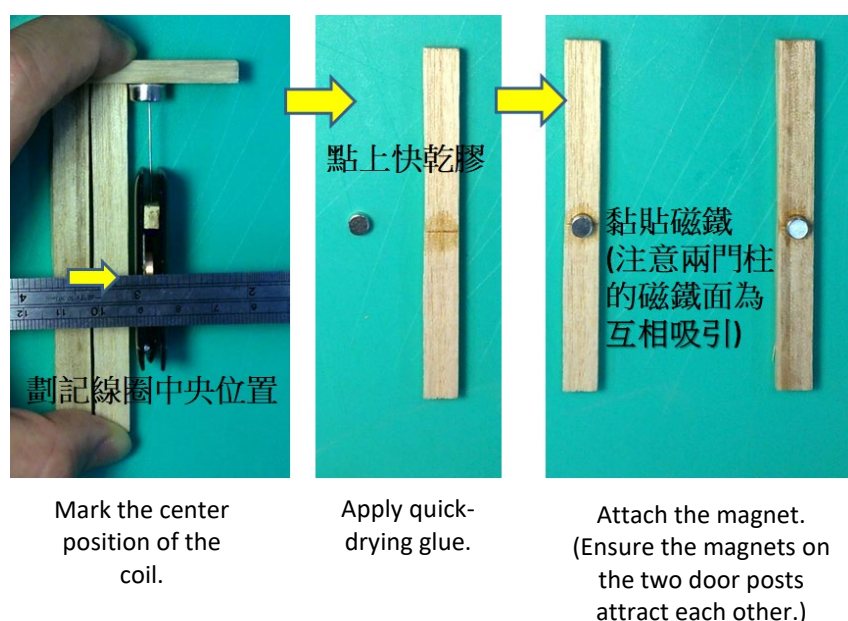


Picture 6. Assemble the Mendocino motor rotor.

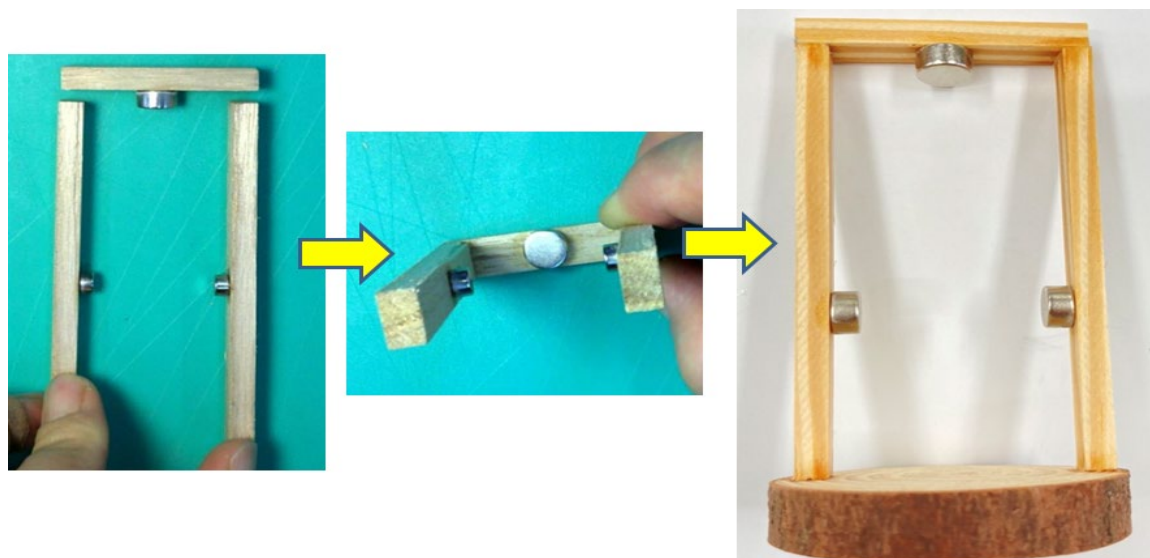
(2) Make the stand.



Picture 7. Attach the magnetic magnet to the top of the stand and the center position.



Picture 8. Mark and attach the magnets on both sides of the door posts (pay attention to the polarity).



Picture 9. Assemble the stand.