Three Nations ENERGY
www.3ne.ca

ELECTRIC Vehicle ACTIVITY

DIY Mini EV

Have fun building a simple electric car with bonus solar panel!

Equipment

MiniMakers Build-It-Yourself Solar Car Kit:

A. AA battery holder
B. Solar panel
C. Double-sided tape
D. Zip ties x 3
E. Plastic gear
F. Switch
G. Wheels x 4
H. DC motor
J. AA battery x 2
K. Heat shrink tubing x 2
L. Metal shaft x 2
M. Pre-cut wood x 5

Also:
Glue gun (with glue sticks)
Electrical tape, Wire stripper
Hair dryer (or heat gun)

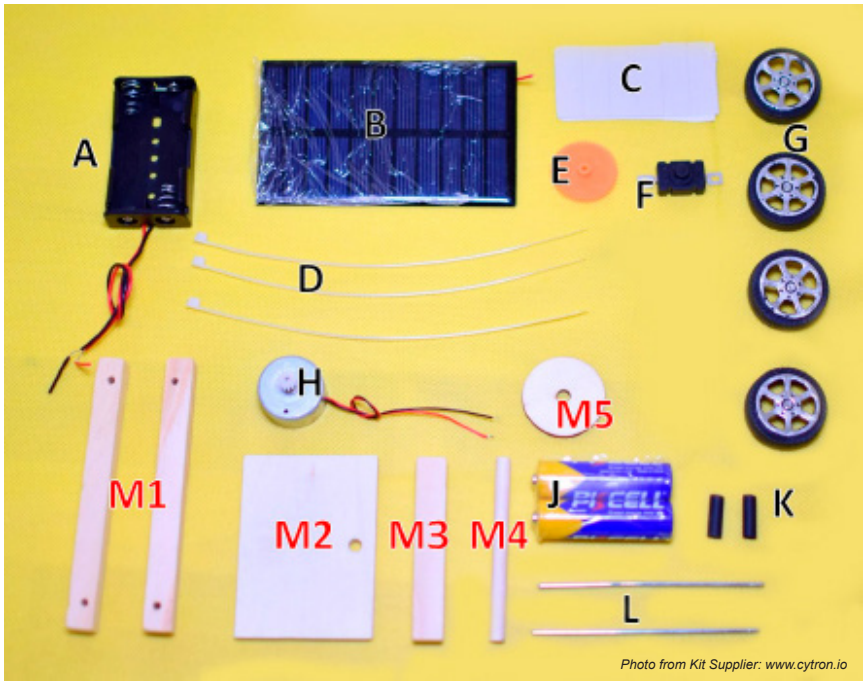
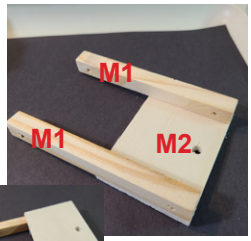


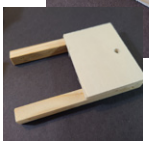
Photo from Kit Supplier: www.cytron.io

OPTIONAL: See the alternative instruction videos on page 4.

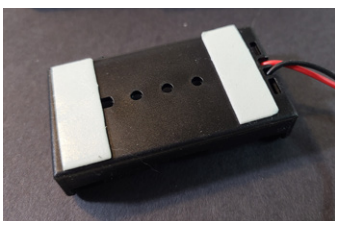
Instructions

Step 1: Stick M1 and M2 wood with glue gun. (A tube of white glue is included with the kit but a glue gun works better.)

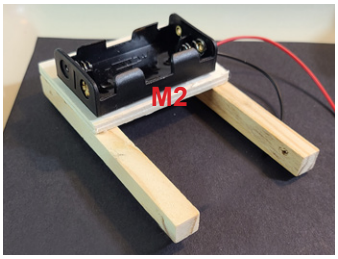




Step 2: Stick two pieces of double-sided tape at the back of the battery holder.



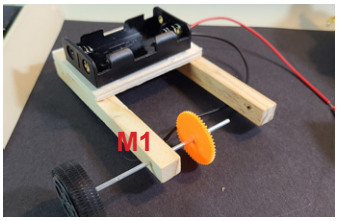
Step 3: Fix the battery holder on top of M2 wood as shown.



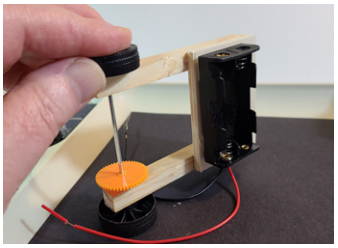
Step 4: Insert a metal shaft (L) into one wheel (G).

Photos: Greenplanet Energy Analytics

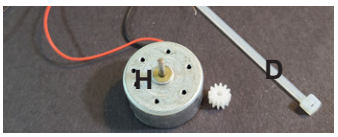
Step 5: Slide the metal shaft through M1 and the large plastic gear (E). Continue through the other side M1.



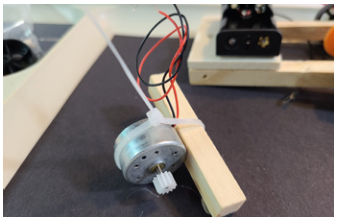
Attach a wheels to the other end of the metal shaft.



Step 6: Check the DC motor (H) - if needed, slide the small drive gear onto the motor drive shaft as shown.



Step 7: Use a zip tie to attach the DC motor onto the M3 wood as shown. Do NOT tighten too much - you will need to adjust the motor position later.



Step 8: Position the M3 wood and motor in front of the M2 wood so it will rest across the two M1 wood.

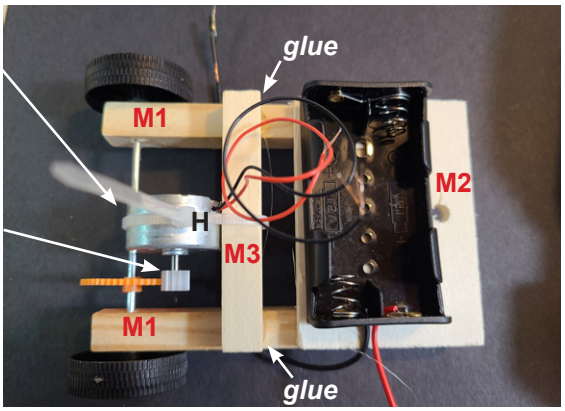
Adjust the position of the large plastic gear (E) on the metal shaft so that the white gear on the DC motor touches the orange plastic gear so has a firm connection but turns easily.

Tighten the cable strap holding the motor.

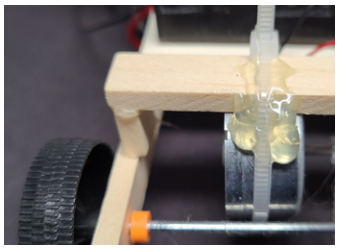
Carefully glue the M3 wood and motor assembly in place so the gears work properly.

Do not let the motor touch the metal shaft

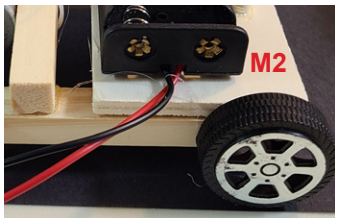
Make sure the gears are touching and able to turn.



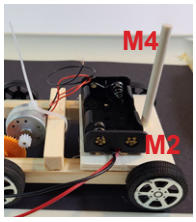
Step 9: Carefully use the glue gun to fix the motor in place on the M3 wood so it does not slide around. ***Be sure to avoid the wires coming out of the motor. The heat could damage them.***

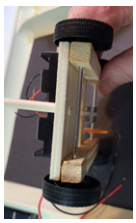


Step 7: Use the remaining metal shaft to attach the rear wheels.

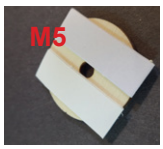


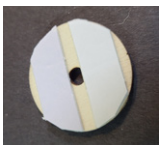
Step 8: Glue the M4 wooden pole to the hole in M2. Make sure the pole does not stick out underneath.



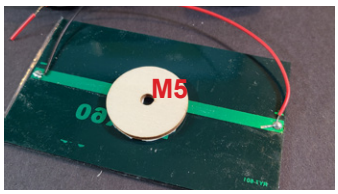


Step 9: Slice and attach two pieces of double-sided tape on top of M5 disk. Trim off the extra.

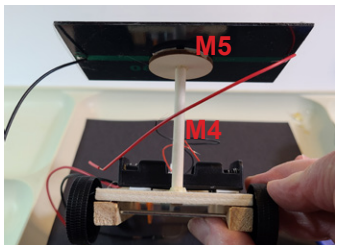




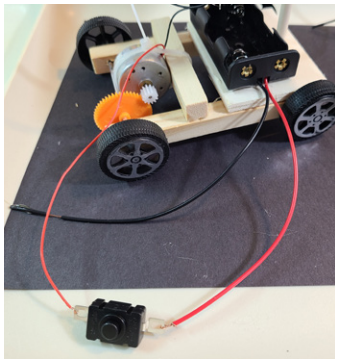
Step 10: Attach the M5 disk to the center back of the solar panel.



Step 11: Put glue on the top end of the M4 wooden pole and place it in the hole of disk M5 so the solar panel lines up over the car body.



Step 12: Connect DC motor positive wire (red) and battery holder positive wire (red) on each side of the switch as shown. Wrap a small piece of electrical tape around these connections.

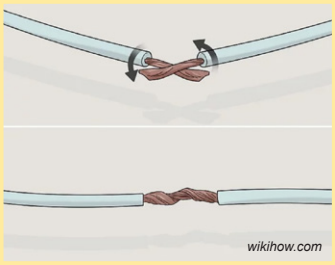


How to Connect Wires

The wires in the kit have the insulation (plastic outside covering) stripped away from the copper wire at the ends so they are ready to connect.

You can use a wire stripper to remove a bit more of the insulation to make connecting easier. *(If you have not used a wire stripper before, practice on some spare wire first.)*

1. To connect the wires, line up the centers of the exposed wires so they form an X-shape.
2. Bend one set of wires down to twist it around the other set as tightly as you can so it has a firm connection. Make sure the end of the wire doesn't stick up or point away from the splice or else you won't have as firm of a connection.



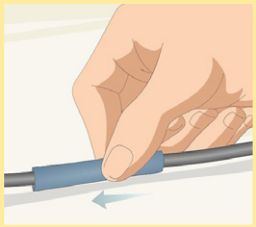
3. Repeat the process with the other wire so your splice looks even on both sides
4. Wrap the connection tightly with electrical tape. You may need to cut the tape to a smaller width to fit properly. Be sure all exposed wire is covered.

Shrink Tubing Connections

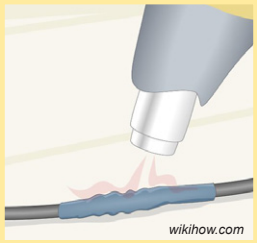
Use this for Steps 13 & 14

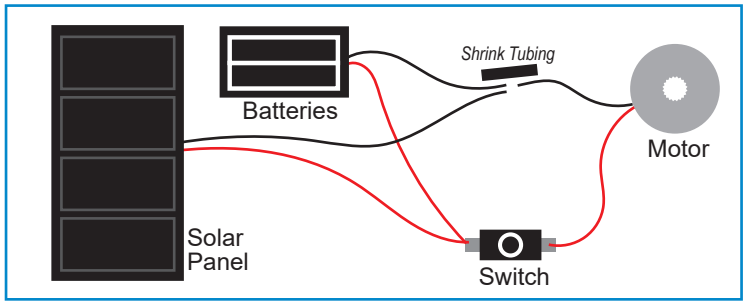
1. Take the wires you wish to connect and slide a piece of shrink tubing onto one wire.
2. Carefully twist the copper wires together to make a good contact as described above.

3. Slide the shrink tubing so it completely covers the exposed wire.
4. Heat the tubing with a hair drier set on high or a heat gun. (Hair dryers need to be held very close while a heat gun needs to be about 7–15 cm away.)



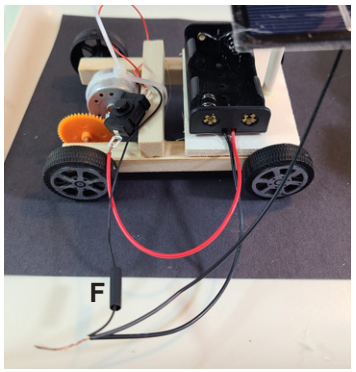
5. Move the nozzle of the hair dryer/heat gun back and forth and rotate the wire as it shrinks. When the tubing is snug and stops shrinking, you are done.
6. Let it cool for about 5 minutes.





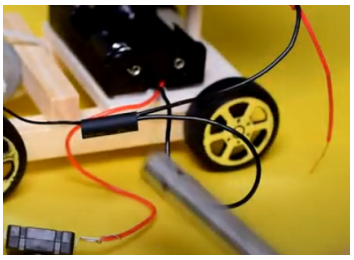
Greenplanet Energy Analytics

Step 13: Slide a piece of shrink tubing onto the black wire of the DC motor as shown.



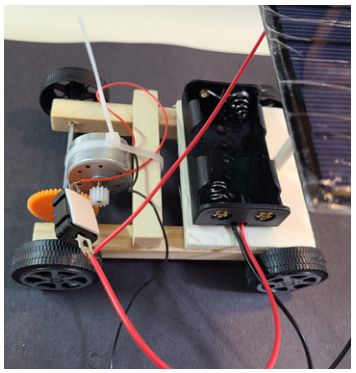
Step 14: Gather the negative (black) wire of the battery holder, DC motor and solar panel.

Twist the 3 wires together and slide the shrink tube (F) to cover the exposed copper.



Step 15: Heat up the heat shrink tube with a hair dryer or heat gun to shrink the tube to protect the connection.

Step 16: Connect the solar panel positive (red) wire to battery holder positive wire on the switch.



Step 17: Stick the switch on top of M3 wood using a double-sided tape.

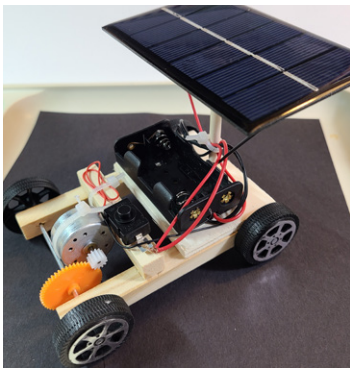
Step 18: Bundle and attach the wires to the frame using zip ties (D).

Congratulations!

Your Solar Powered Car is ready for action.

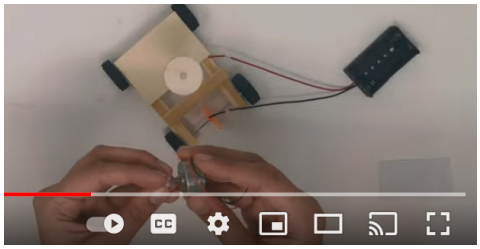
TAKE NOTE:

1. The batteries provided are not rechargeable. Insert the 2 AA batteries (non-rechargeable) to run without solar power. ***(Do not try to charge non-rechargeable batteries.)***
2. Place the car under sunlight to operate without any batteries.



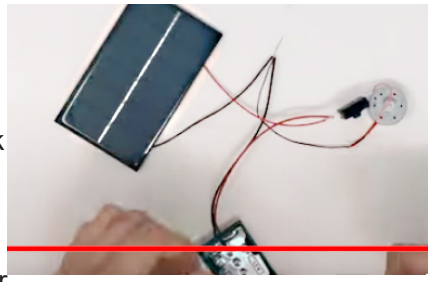
How-To Videos

Solar Panel Powered Car Kit Instructional Video - MiniMakers



This video shows an alternative way of assembling the MiniMakers solar car kit.

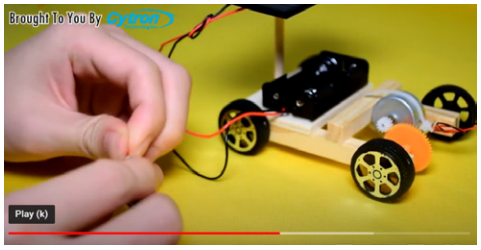
- This shows a different approach by connecting all the wires first and then mounting parts on the frame.



- It does not include how to use the shrink tubing or how to apply electrical tape.
- The video shows assembling the motor support early in construction which can cause problems if the distance between the motor and large gear is too great.

https://www.youtube.com/watch?v=Epk0G1cXBhE&t=243s

Assembly of DIY Solar Powered Car - Cytron Technologies



This video shows an alternative way of assembling a similar solar car kit.

- It does not include how to apply electrical tape.
- It also shows assembling the motor support early in construction which can cause problems if the distance between the motor and large gear is too great.
- The motor in this kit is installed in the opposite direction. If you followed these instructions your car would run backwards. This could be overcome by switching the wires connected to the red and black wires of the motor.

https://www.youtube.com/watch?v=E9hiDyYuHW0

Let's Take It Further

MEASURE THE SPEED

Design a test to measure the speed of your car. Suggestions:

- Use fresh batteries. Cover the solar panel so no extra electricity is added.
- Find a long smooth area to run tests like a hallway. The longer the distance, the more accurate it will be.
- Mark off the start and end point. Measure and record the Distance in metres.
- Use a timer on a smart phone or watch.
- Time the car from beginning to end at least 3 times and record them (T1, T2, T3) in seconds.
- Do the math:
  Average the three times together first:
  Average Time = (T1+T2+T3)/3
  measured in seconds
  Then calculate the Speed:
  Speed = Distance / Average Time
  where distance is in metres (m), time is in seconds (s) and speed ends up in metres per second (m/s)

COMPARE WITH SOLAR

Repeat the above experiment for Solar alone. Suggestions:

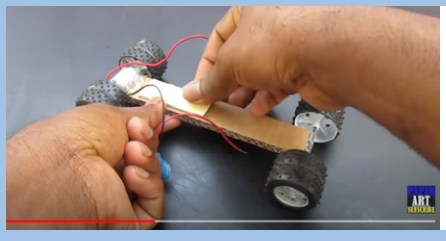
- Remove the batteries.
- Find a smooth place to run the car (see instructions above.)
- Be sure to take into account the brightness of the sunlight - cloudy or full sun, time of day, angle of the sun. More light means more electricity and speed.
- Compare this to the speed of the EV model with batteries and a covered solar panel.

FOR FUN

Have a race! Set up a track and compete with each other.

FOR A CHALLENGE

Builld an electric car from scratch.
https://www.youtube.com/watch?v=Lxrsh3sP9M4



Teacher Notes: DIY Mini EV - Curriculum Connections & Sources

Science Grade 9

Unit D: Electrical Principles and Technologies

1. Investigate and interpret the use of devices to convert various forms of energy to electrical energy, and electrical energy to other forms of energy

- Construct, use and evaluate devices for transforming mechanical energy into electrical energy and for transforming electrical energy into mechanical energy

2. Describe technologies for transfer and control of electrical energy

- Investigate toys, models and household appliances; and draw circuit diagrams to show the flow of electricity through them (e.g., safely dismantle discarded devices, such as heating devices or motorized toys, and draw diagrams to show the loads, conductors and switching mechanisms)

Science 14

Unit B: Understanding Energy Transfer Technologies

3. Describe and compare simple machines as devices that transfer energy and multiply forces or distances

- Explain the need to encourage and support the development of machines that are efficient and rely upon renewable energy sources (e.g., hand-wound radios, solar-powered calculators, solar cookers)

Sources for these solar car kits:

https://www.amazon.ca/gp/product/B09KZLN7VX/ref=ppx_yo_dt_b_search_asin_title?ie=UTF8&psc=1

https://www.cytron.io/p-diy-solar-powered-car-w-batteries

https://mavigadget.com/products/diy-creative-children-solar-car-kit/

Science 24

Outcomes for Science, Technology and Society (STS) and Knowledge

1. Investigate and interpret transformation and conservation of various forms of energy in physical and technological systems

- Design, construct and evaluate a simple model or device that transforms energy from one form to another (e.g., windmill, water wheel, model vehicle powered by rubber bands/mousetraps/carbon dioxide/electric motor)

2. Investigate and analyze electrical energy conversion devices in terms of energy conversions, rate of energy transfer and efficiency

- Compare the efficiency of electrical power distribution systems by tracing the energy conversions that occur in a variety of household devices (e.g., power tools; electric cars; microwave and conventional ovens; fluorescent, incandescent and halogen light bulbs)

Unit B: Understanding Common Energy Conversion Systems

Science 10

Unit B: Energy Flow in Technological Systems

- Forms of energy, energy transformation, renewable and non-renewable energy
- Efficient use of energy and the environmental impacts of the inefficient use of energy
- Explain the need for efficient energy conversions to protect our environment and to make judicious use of natural resources (e.g., advancement in energy efficiency; Aboriginal perspectives on taking care of natural resources)

Science 20

Unit B: Changes in Motion

Specific Outcomes for Science, Technology and Society

- Explain that the goal of technology is to provide solutions to practical problems

Science 30

Unit C: Electromagnetic Energy

Key Concepts:

- Devices based on electric and magnetic fields (electric motors, generators and transformers)
- Circuitry

CAREER AND TECHNOLOGY STUDIES (CTS)

Natural Resources (NAT)

The focus of the NAT cluster is for students to develop and apply the knowledge, skills and attitudes to work individually and collectively, as private citizens and as members of the work force, toward the conservation and responsible use of energy and natural resources.

Trades, Manufacturing & Transportation (TMT)

The focus of the TMT cluster is for students to develop and apply important knowledge, skills and attitudes relative to the manufacture and assembly of products from individual components and the processing of raw materials into products.

Sources for wiring instructions:

https://www.wikihow.com/Solder-Wires-Together

https://www.wikihow.com/Use-Heat-Shrink-Tubing