



Laneview STEM Day

Presented by Students Advancing Stem and the Laneview PTA

Let's Make a Drone

K/1

Let's Make a Drone (Grades 4 and 5)

- Welcome and Introductions
- Students Advancing Stem (SAS)
 - High school and middle school students interested in science
 - Putting together and presenting programs for elementary school students
 - SAS clubs at both Morrill and Sierramont Middle Schools and Piedmont Hills High School.



Let's Fly a Drone (Grades 4 and 5)

- **What is a drone?**

- Also called an Unmanned Aerial Vehicle (UAV), is an aircraft without a pilot on board.
- Drones have many uses. These include military, recreation, maintenance and several other areas.
- Because of people not being responsible, drones are not allowed to fly in national parks after a drone crashed into one of the hot springs in Yellowstone.
- Drones can be such a nuisance that a Dutch police force is training eagles to combat drones.



Let's Fly a Drone (Grades 4 and 5)

- **What is a drone? (cont.)**

- The earliest attempt to make a drone was in 196.
- Drones have many uses. These include military, recreation, maintenance and several other areas.
 - Military drones are operated by highly trained pilots.
 - Drones are used for aerial surveillance of large areas – such as monitoring livestock, mapping wildfires, home security, road patrol and many other activities.



Let's Fly a Drone (Grades 4 and 5)

- **How do drones work?**

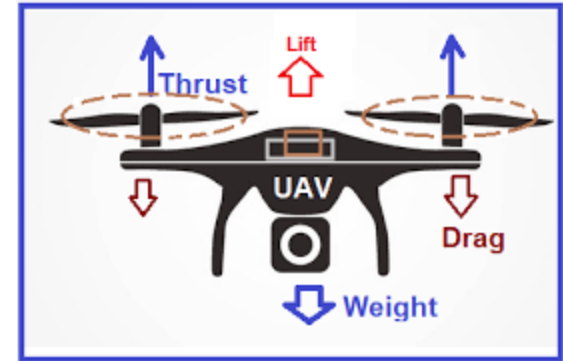
- Typically have four rotors (propellers) that are arranged in an “X” pattern.
- Two propellers turn in a clockwise (CW) direction and the two opposite propellers turn in a counterclockwise (CCW) direction.
 - Propellers that are across from each other diagonally spin in the same direction.
- To rise into the air – or lift off, the spinning propellers (rotor) must push air downward.
 - The air pushes up on the rotors and causes the drone to rise or lift up.



Let's Fly a Drone (Grades 4 and 5)

- **What is Lift?**

- The push that lets something move up.
- It is the force that is opposite of weight.
- Everything that flies must have lift.
- For an airplane to fly, it must have more weight than lift.
- The lift for the drone comes from the rotor blades (propellers) at the top of the drone.
- This diagram also shows thrust and drag. We will not cover those concepts in this session.
- Lift is covered in Newton's Third Law and in this short video:
- Eyes in the Skies! The Incredible World of Drones:
<https://www.youtube.com/watch?v=abxjyL9iuvo>



Let's Fly a Drone (Grades 4 and 5)

- **What is Newton's Third Law**

- Issac Newton lived 400 years ago.
- He created 3 "Laws" that are very important to scientists.
- The third law says: "Every action has an equal and opposite reaction."
- When the circuit on your drone is connected, the propellers (rotors) spin and produces force (an action) which pushes the skateboard forward (an equal and opposite reaction).
- Here is a short video that explains Newton's Third Law.
- <https://www.youtube.com/watch?v=6XNJDJTvenY> (1:47)



Let's Fly a Drone (Grades 4 and 5)

- **Powering the Drone**

- The rotors (propellers) will not move without power.
- The drone you are making uses a battery powered circuit to provide power.

- **What is a Circuit?**

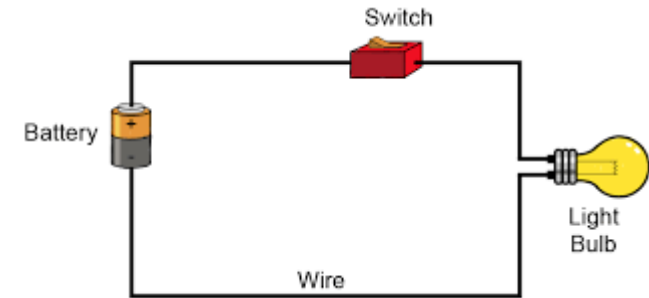
- Paths for transmitting electric current or moving electricity.
- They allow electricity to be used to provide power to lights, appliances, computers and many other devices.



Let's Fly a Drone (Grades 4 and 5)

- **Parts of a Circuit:**

- It must have a power source.
 - Flashlights – power source is a battery
 - Homes or Schools – power source is a public power plant.
 - Today, we are using batteries as our power source.
- Wires carry the electricity in the circuit.
 - Made of metal and covered in plastic
 - The plastic keeps the electricity contained so it is safe to use.
 - Wires will connect the battery to the motors and propellers.
 - The wires must be connected correctly for the current to flow.
 - You will be given VERY SPECIFIC directions on how to connect the wires as we build the drone.



Let's Fly a Drone (Grades 4 and 5)

- **On-Off Switches**

- Allow you to control the flow of electricity through the circuit
- When a switch is connected, it completes the circuit and electricity flows
- When the switch is disconnected, it breaks the circuit and electricity stops flowing.
- Your drone on-off switch is called an ***Alligator Clip***.
 - When you connect the alligator clip to the black battery wire, the propeller moves.
 - When you disconnect the alligator clip to the black battery wire, the propeller stops.

- **Video:**

- This video, called “Introduction to Simple Circuits” explains how circuits work.
- <https://www.youtube.com/watch?v=zSSkZ9F7Bng> (2:52)



Let's Fly a Drone (Grades 4 and 5)

Let's Build Your Drone!!!

- This is a complex project.
- Please follow the instructions as they are given to you.
- DO NOT try to move ahead.
- DO NOT take out the parts until you are instructed to do so.
- The motors break easily and there are no extra parts if you break something.



Let's Fly a Drone (Grades 4 and 5)

- **Parts List**

- Drone Base

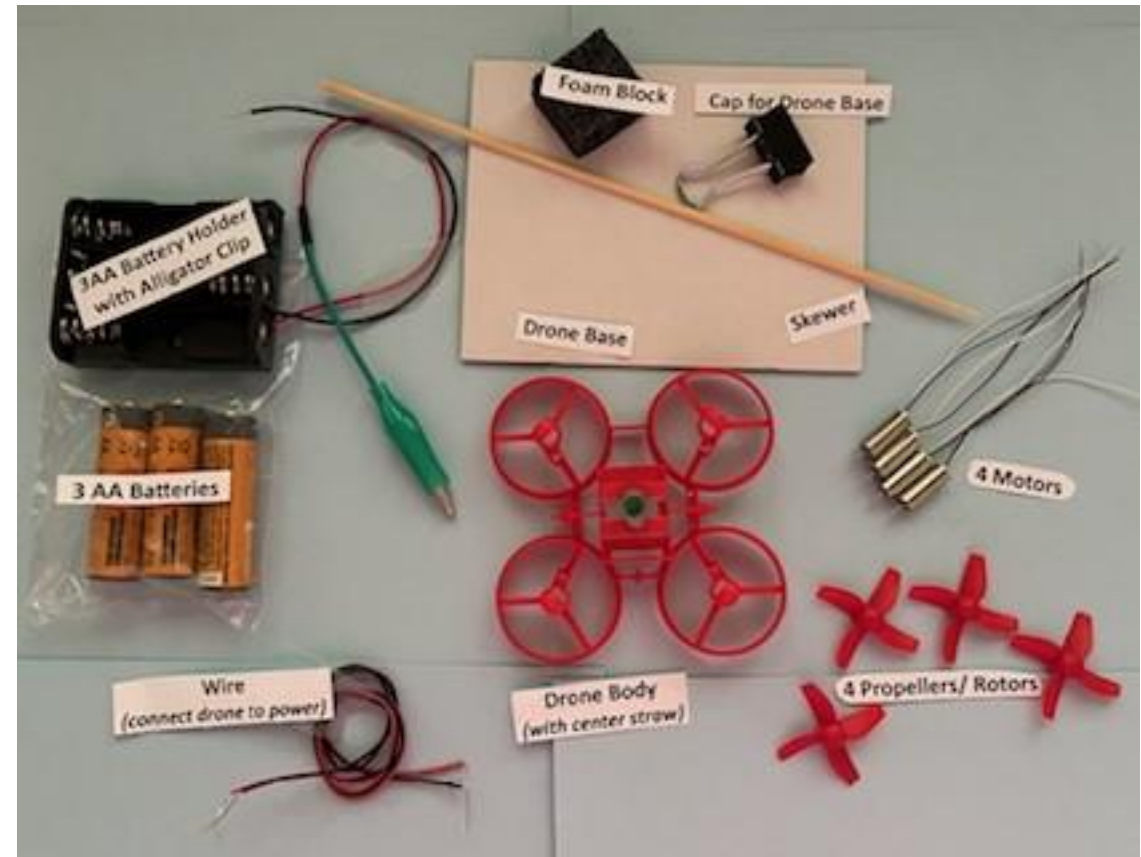
- Cardboard base
 - Foam base
 - Skewer
 - Cap

- Body

- Body with straw in middle
 - 4 Motors
 - Rotors/Propellers
 - Wire

- Power Supply

- Battery holder with alligator clip (on/off switch)
 - 3 AA Batteries

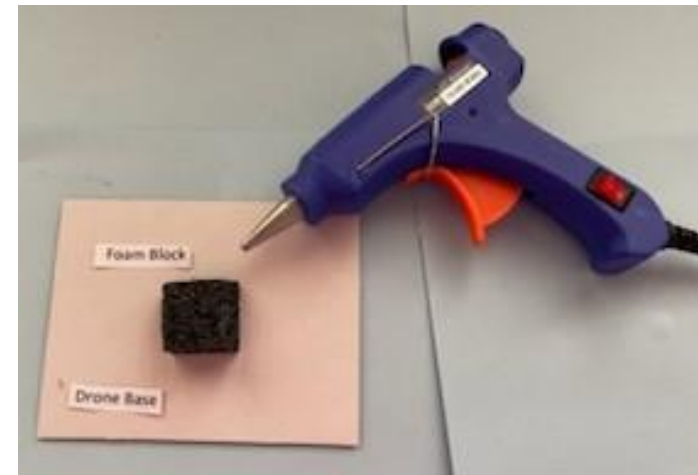
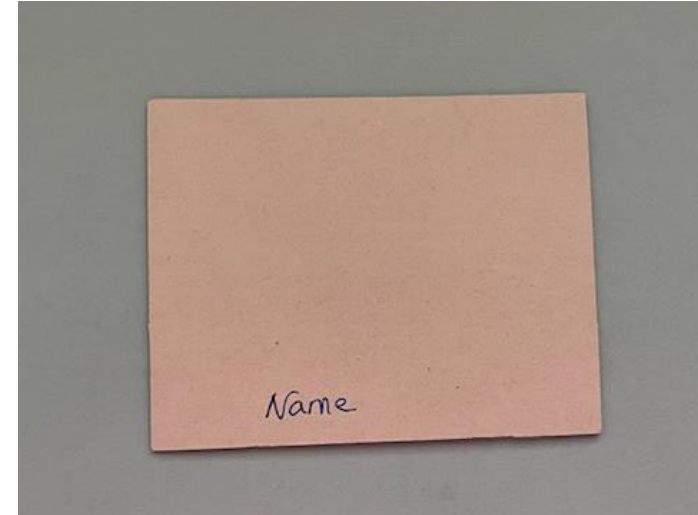


Let's Fly a Drone (Grades 4 and 5)

STEP One: Set up the base.

(Base will support drone when you turn it on.)

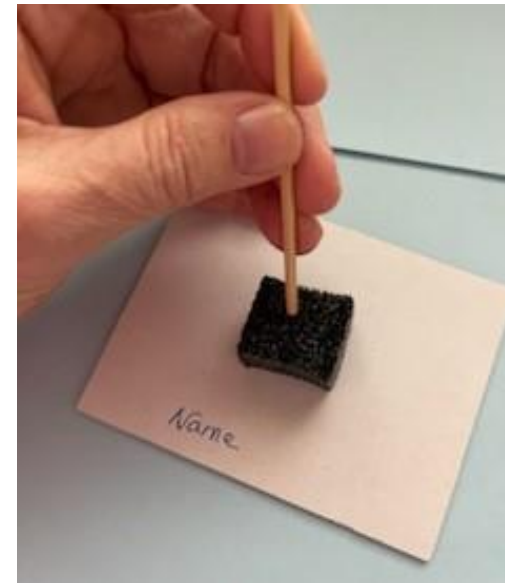
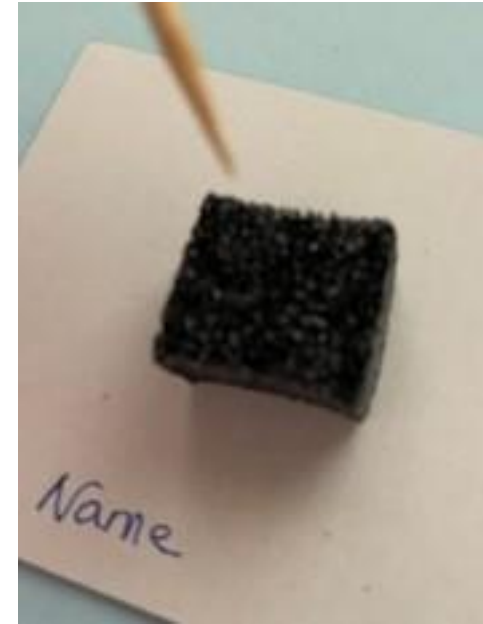
- Remove the drone base, skewer, foam block and drone cap from your bag.
- Write your name on the base.
- Using a hot glue gun, glue the bottom of foam block to the **CENTER** of the base.



Let's Fly a Drone (Grades 4 and 5)

STEP One: Set up the base. (Cont)

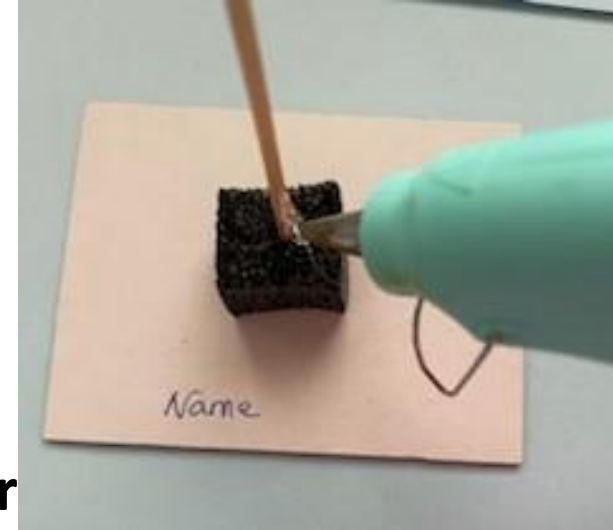
- Take the pointed end of the skewer.
- Poke a hole in the base.
- Turn the skewer around and place the flat end into the foam block.
(You need to poke a hole in the base before you can insert the skewer.)



Let's Fly a Drone (Grades 4 and 5)

STEP One: Set up the base. (Cont)

- Apply about 8 to 10 squeezes of the glue gun trigger to put glue around the skewer.
- The extra glue is needed to hold the skewer in place when you launch your drone.
- Place the cap on the end of the skewer so it does not get lost.
- Set the base aside and let it dry.



Let's Fly a Drone (Grades 4 and 5)

STEP TWO: Add Motors and Rotors (Propellers) to Body

- Take the drone body and the package with the motors and rotors out of your bag.
- Leave to propellers/rotors in the small bag until you are told to take them out.
- Notice that the motors are magnetic.
 - Electric motors use magnets to create motion.



Let's Fly a Drone (Grades 4 and 5)

STEP TWO: Add Motors and Rotors (Propellers) to Body

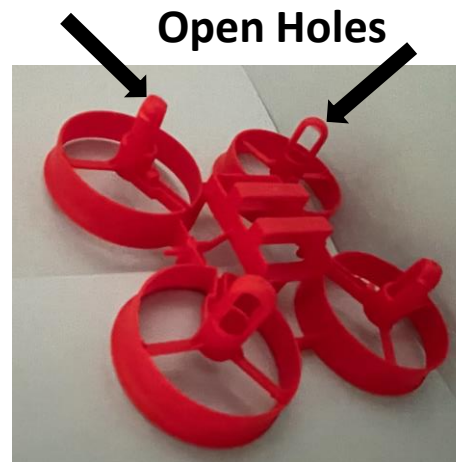
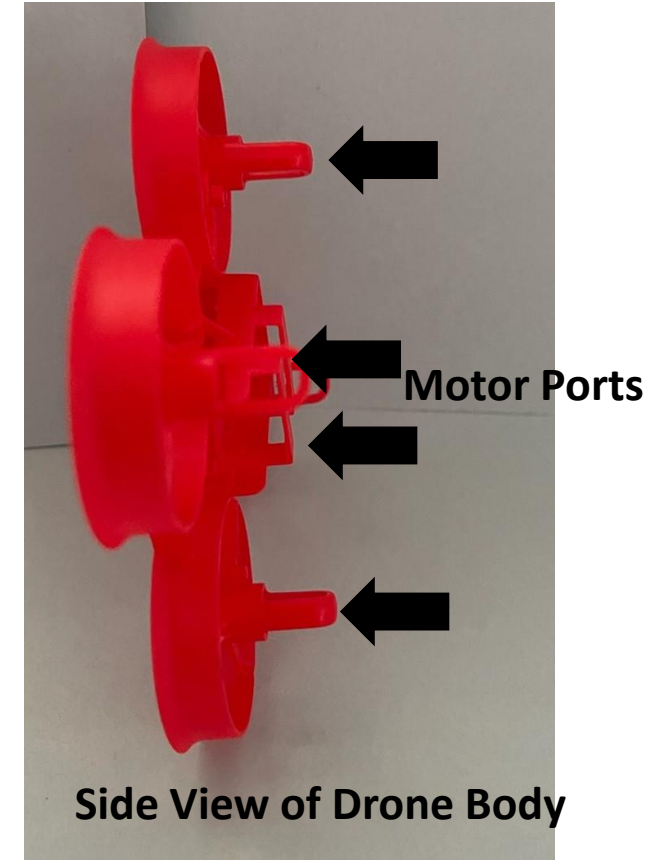
- **How an Electric Motor Works**
 - It converts electrical energy into mechanical energy.
 - It works due to electromagnetic interactions.
 - You put in electricity (current from the battery) into the motor at one end and the axle (metal rod) rotates.
 - Every motor has a magnetic field.
 - This is a small motor, so the magnets are not protected and you feel the magnetic force.



Let's Fly a Drone (Grades 4 and 5)

STEP TWO: Add Motors and Rotors (Propellers) to Body

- There are 4 motor ports on the drone.
- The motors will be placed into the motor ports.
- Be very careful. The motors can break. We don't have extra parts if something breaks.
- Look for the open holes on the bottom of the drone body.



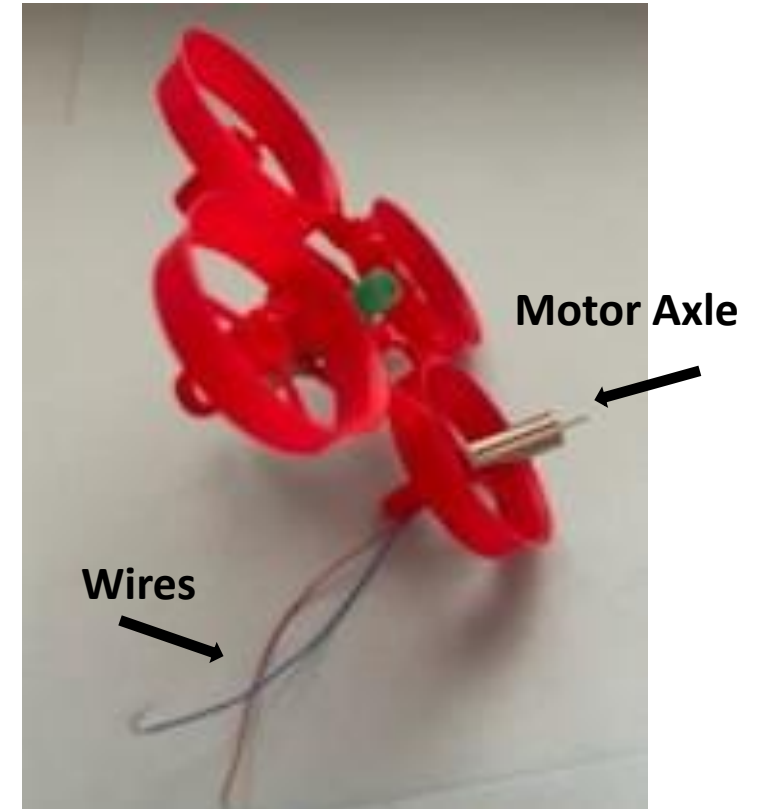
Bottom View of Drone Body



Let's Fly a Drone (Grades 4 and 5)

STEP TWO: Add Motors and Rotors (Propellers) to Body

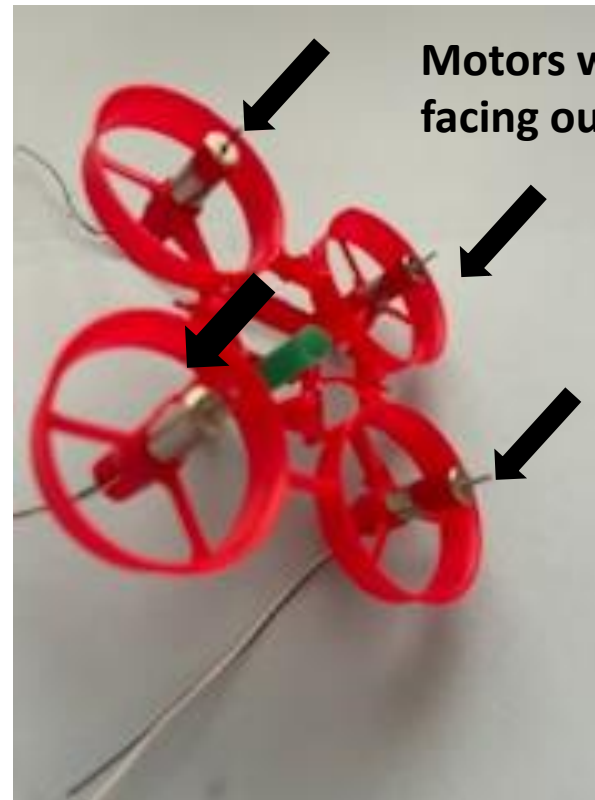
- Take one motor at a time.
- Thread the wires into the motor port.
- The motor axle is facing outward.
- Put the wires through the holes in the base and GENTLY pull them through.
- GENTLY push the motor into the hole until it is secured.
- GENTLY pull the wires through the hole.
- Repeat for all 4 motors.



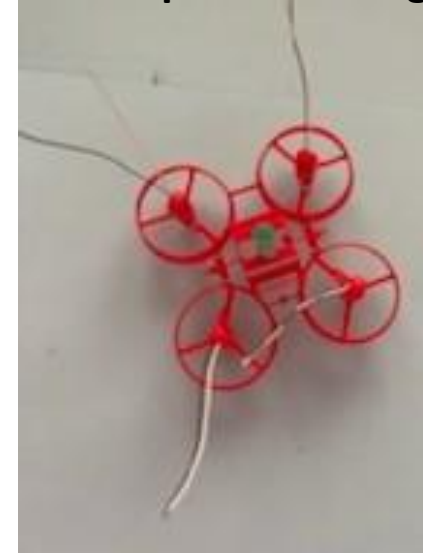
Let's Fly a Drone (Grades 4 and 5)

STEP TWO: Add Motors and Rotors (Propellers) to Body

- All motors are in the base.
- The wires should be hanging freely from the bottom port.
- You will be connecting these wires to each other.



Wires pulled through

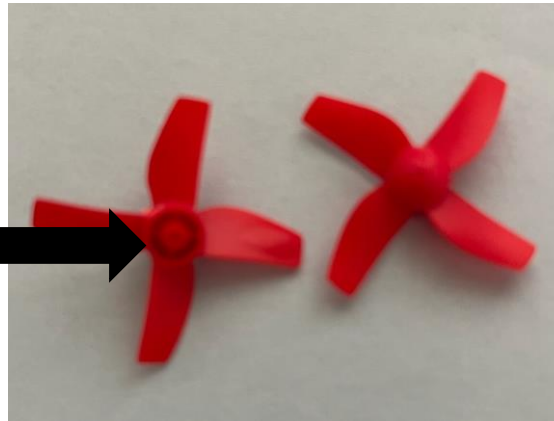
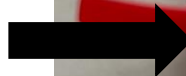


Let's Fly a Drone (Grades 4 and 5)

STEP TWO: Add Motors and Rotors (Propellers) to Body

- Now, take the propellers (rotors) out of their bag.
- Turn the propeller over.
- Look for the small hole on the bottom.

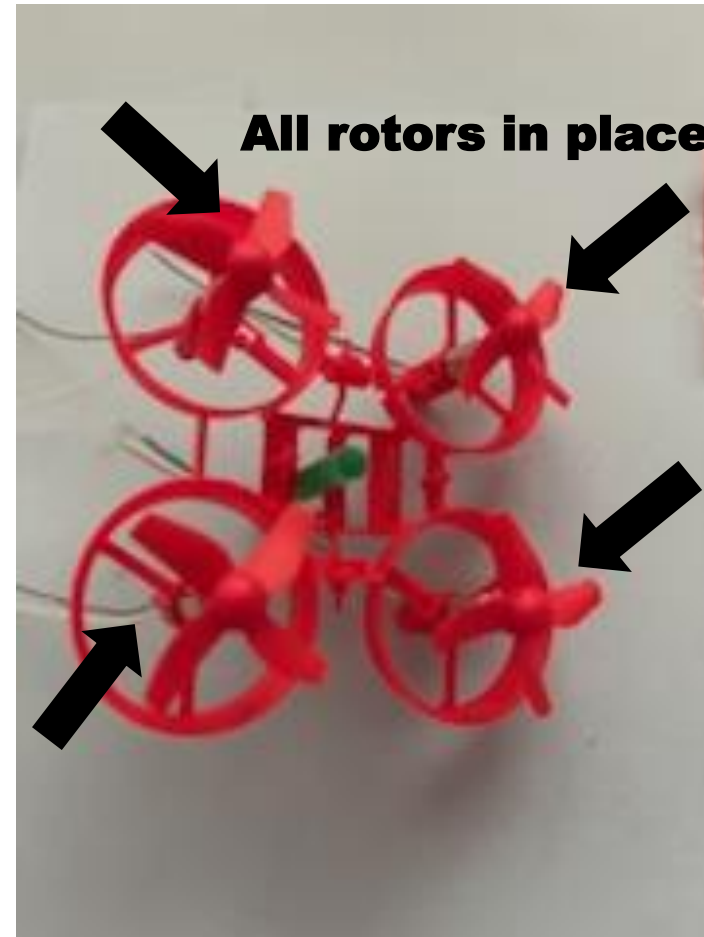
Small Hole



Let's Fly a Drone (Grades 4 and 5)

STEP TWO: Add Motors and Rotors (Propellers) to Body

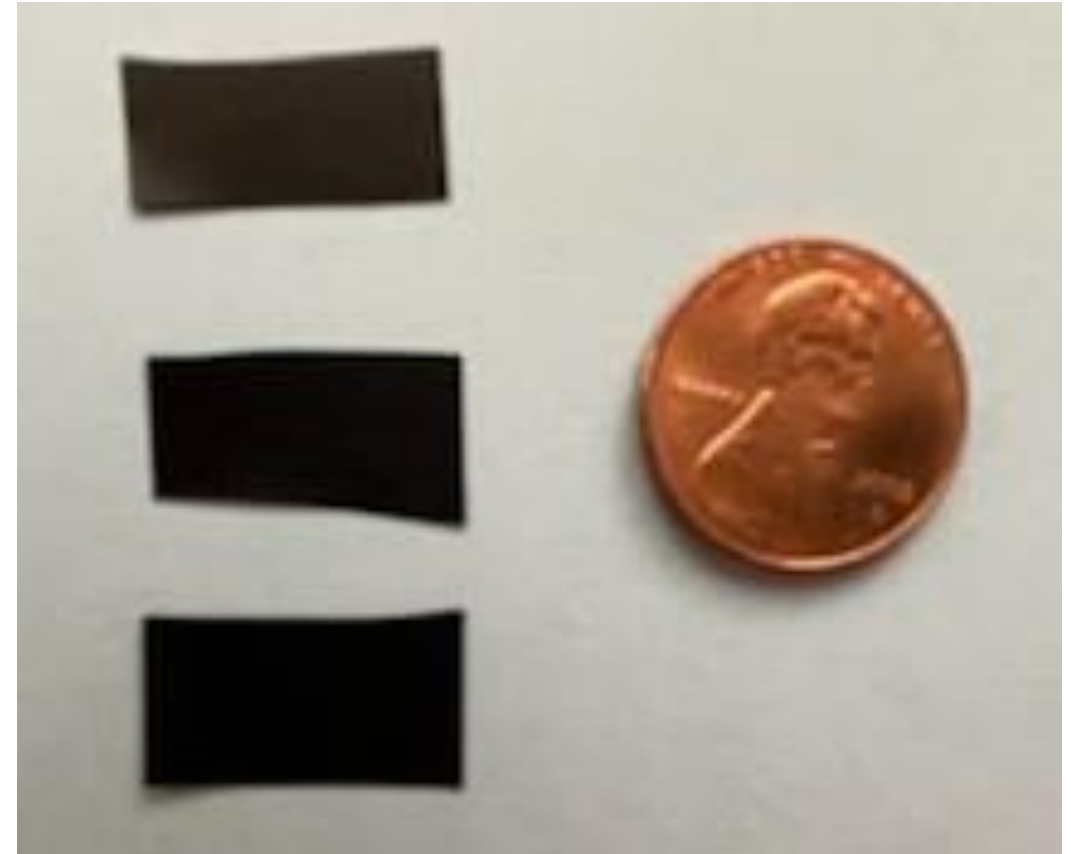
- Take a propeller (rotor) and place it on a motor axle.
- GENTLY push down until the propeller (rotor) is secured on the axle.
- Do this for all four propellers (rotors).



Let's Fly a Drone (Grades 4 and 5)

STEP Three: Connecting Motor Wires

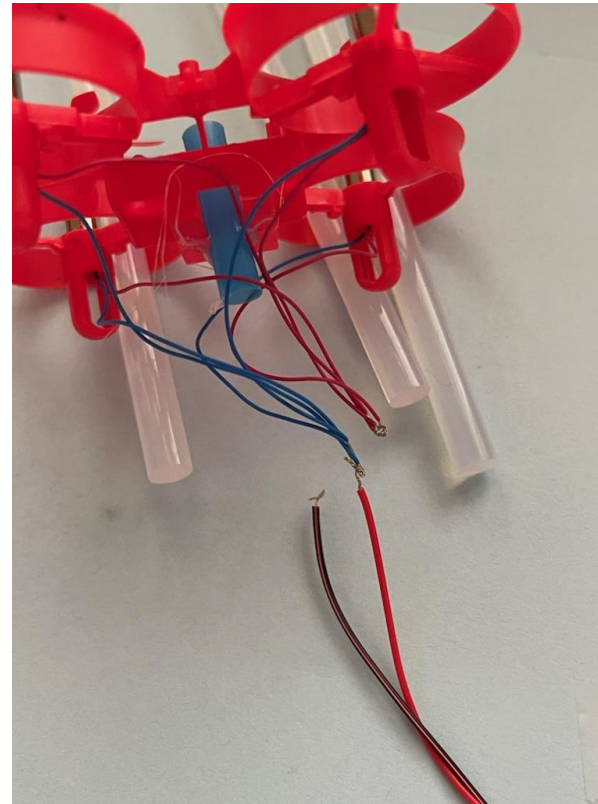
- Wires must be properly connected to make the electrical circuit.
- Cut 3 small pieces of electrical tape. One just a bit larger than the other two.
(Electrical tape, if applied correctly, keeps the wires secured together.)
- Make sure you do not cut too much tape.
- Tape adds to the weight of the drone and it won't lift properly if it is too heavy.
- Put the pieces of tape on the table in front of you. You will use them soon.



Let's Fly a Drone (Grades 4 and 5)

STEP Three: Connecting Motor Wires (Group A-1)

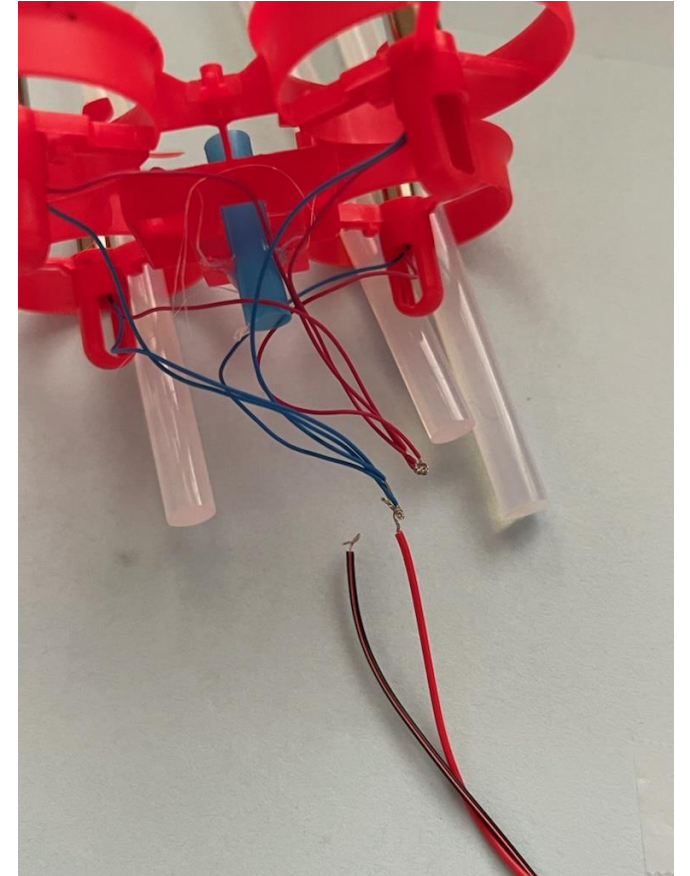
- Turn over the drone base.
- You will see 4 sets of wires – one for each rotor.
- Your wires are red and blue.



Let's Fly a Drone (Grades 4 and 5)

STEP Three: Connecting Motor Wires (Group A-2)

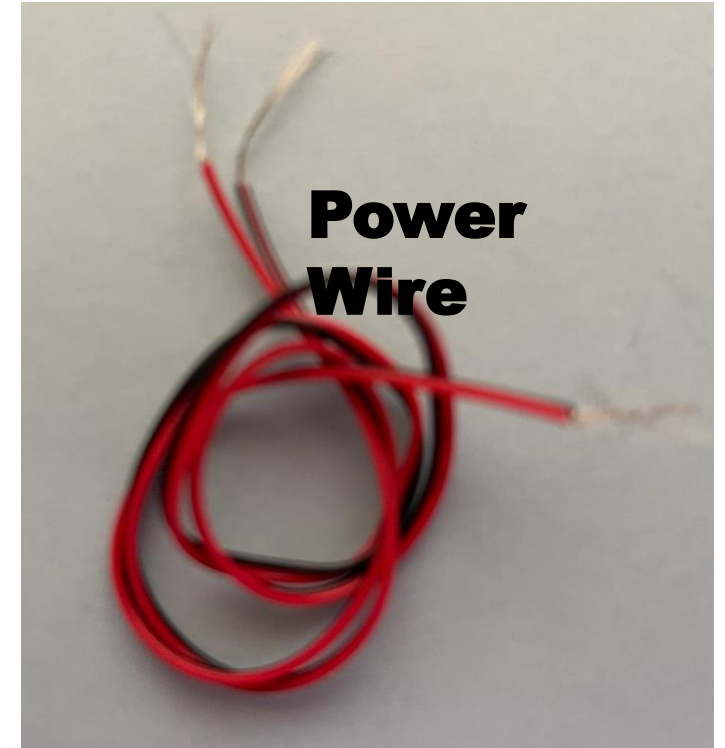
- Take all of the **blue wires** and put the ends together.
- Twist all four ends together.
These are very small so pay close attention.
- Then take all of the **red wires**.
- Twist all four ends of the wires together.



Let's Fly a Drone (Grades 4 and 5)

STEP Three: Connecting Motor Wires (Group A-3)

- Take the red and black power wire out of the bag.
- Straighten out the wire.
- You will connect the black power wire to the **red motor** wires.
- You will connect the **red power wire** to the **blue motor** wires.



Let's Fly a Drone (Grades 4 and 5)

STEP Three: Connecting Motor Wires

(Group A-2.1)

- You will connect the **red power wire** to the **blue motor wires**.
- Put the **red power wire** next to the **blue motor wires**.
- Gently twist the wires until they are secured to each other.

BLUE motor wires

Black power wire

RED motor wires

RED power wire

4 Blue motor wires

Red power wire

Twist the wires together

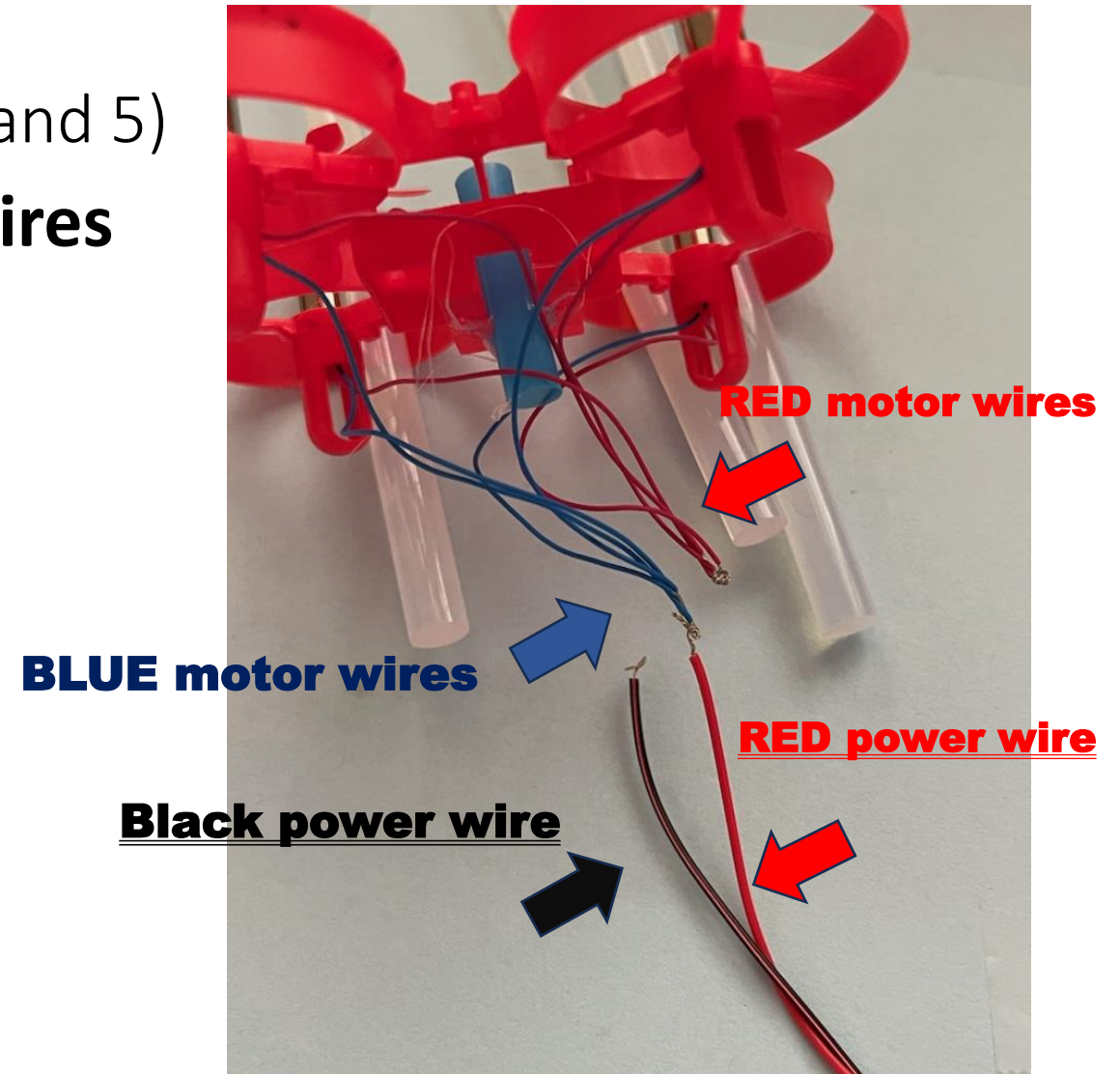


Let's Fly a Drone (Grades 4 and 5)

STEP Three: Connecting Motor Wires

(Group A-4)

- You will connect the black power wire to the **red motor** wires.
- You will connect the **red power wire** to the **blue motor** wires.
- The next slides will show you how to connect wires correctly.

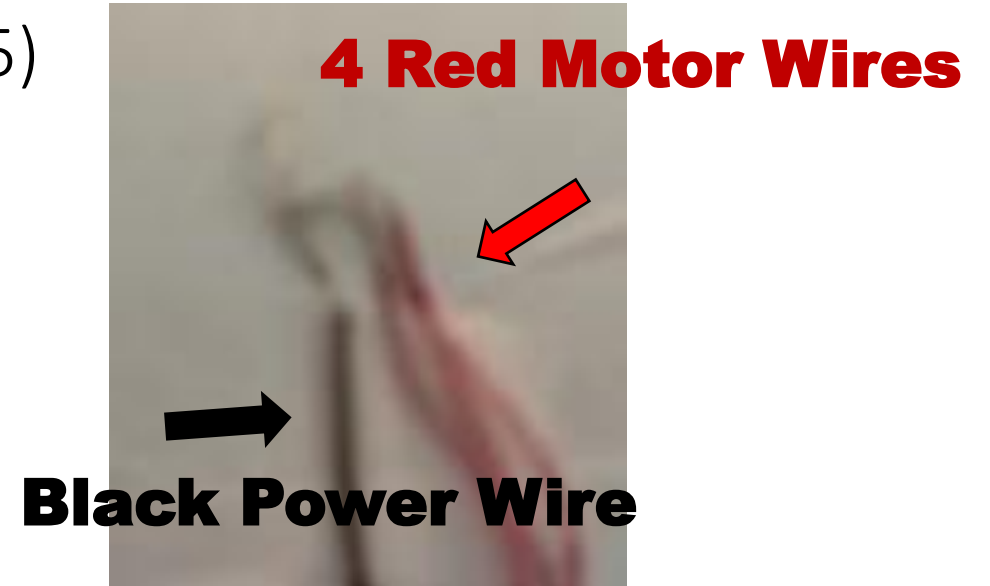


Let's Fly a Drone (Grades 4 and 5)

STEP Three: Connecting Motor Wires

(Group A-5)

- Put the black power wire side by side with the **4 red motor** wires.



- Gently twist the wires until they are secured to each other.

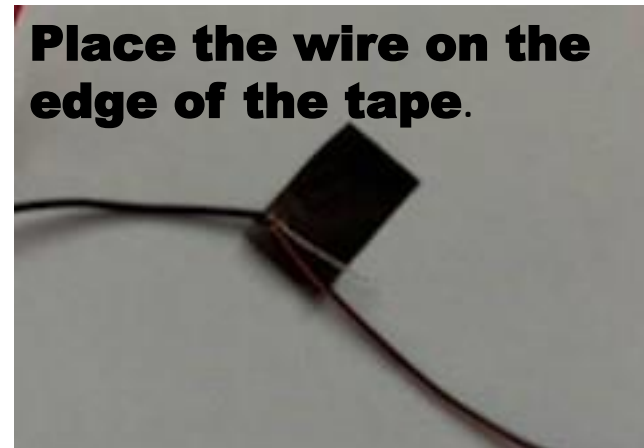


Let's Fly a Drone (Grades 4 and 5)

STEP Three: Connecting Motor Wires

(Group A-6)

- Straighten out the wires so the **red motor wires** and the black power wire makes a line.
- Fold the wires over until they lie on top of the black power wire.
- Take one of the pieces of electrical tape. Make sure the sticky side is facing up.
- Set the wires on the edge of the electrical tape.



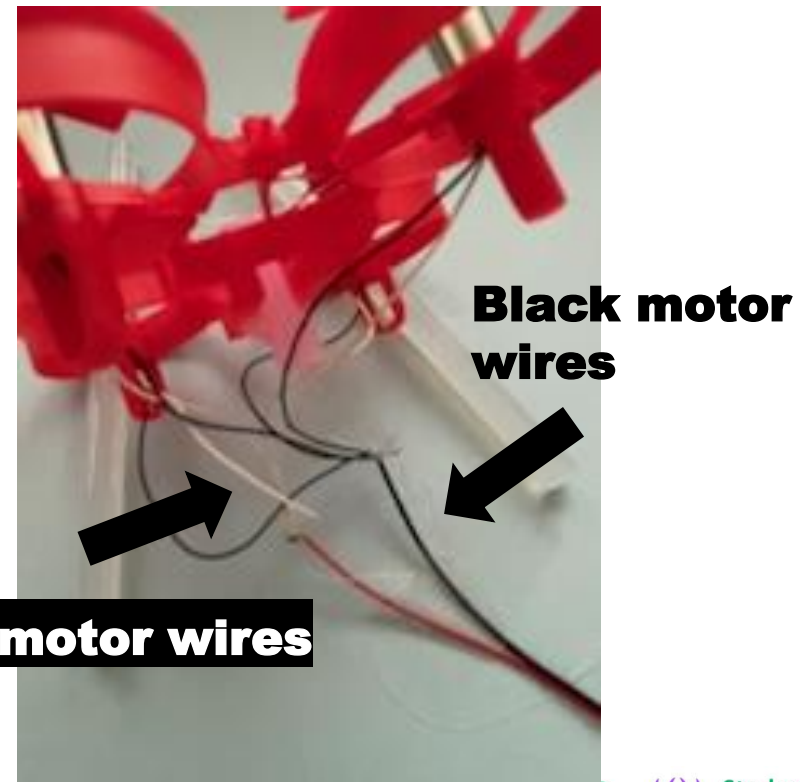
Wrap the tape around the wires and pinch it to make sure it is secure.



Let's Fly a Drone (Grades 4 and 5)

STEP Three: Connecting Motor Wires (Group B-1)

- Turn over the drone base.
- You will see 4 sets of wires – one for each rotor.
- Your wires are **black** and **white**.



Let's Fly a Drone (Grades 4 and 5)

STEP Three: Connecting Motor Wires (Group b)

- Take all of the **black wires** and put the ends together.
- Twist all four ends together.

These are very small so pay close attention.

- Then take all of the **white motor wires**.
- Twist all four ends of the wires together.

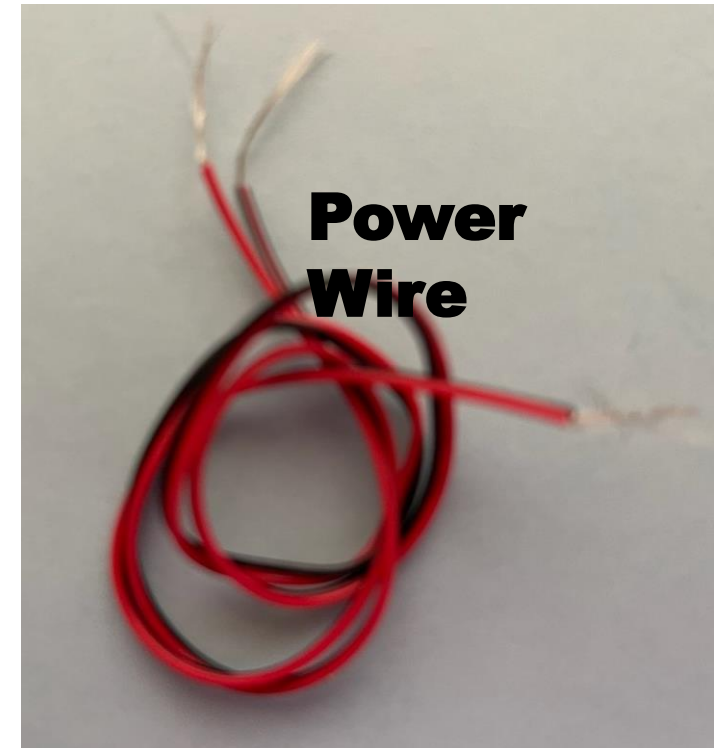


White motor wires

Let's Fly a Drone (Grades 4 and 5)

STEP Three: Connecting Motor Wires (Group A)

- Take the red and black power wire out of the bag.
- Straighten out the wire.
- You will connect the **black power wire** to the **black motor** wires.
- You will connect the **red power wire** to the **white motor** wires.



Let's Fly a Drone (Grades 4 and 5)

STEP Three: Connecting Motor Wires

(Group A)

- You will connect the **red power wire** to the **white motor** wires.
- Put the **red power wire** next to **White motor wires** the **white motor** wires.
- Gently twist the wires until they are secured to each other.



Red Power Wire



Twist the wires together

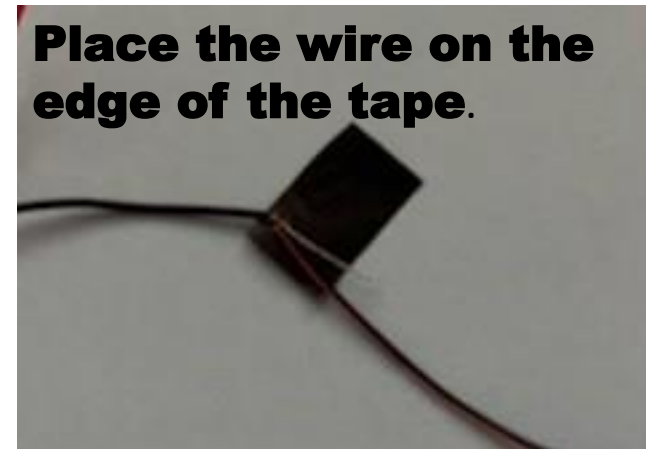


Let's Fly a Drone (Grades 4 and 5)

STEP Three: Connecting Motor Wires

(Group A)

- Straighten out the wires so the **red power wire** and the **white motor wires** make a line.
- Fold the wires over until they lie on top of the black power wire.
- Take one of the pieces of electrical tape. Make sure the sticky side is facing up.
- Set the wires on the edge of the electrical tape.



- Wrap the tape around the wires and pinch it to make sure it is secure.



Let's Fly a Drone (Grades 4 and 5)

STEP Three: Connecting Motor Wires

(Group B)

- Put the **black power wire** side by side with the **4 black motor wires**.

Gently twist the wires until they are secured to each other.

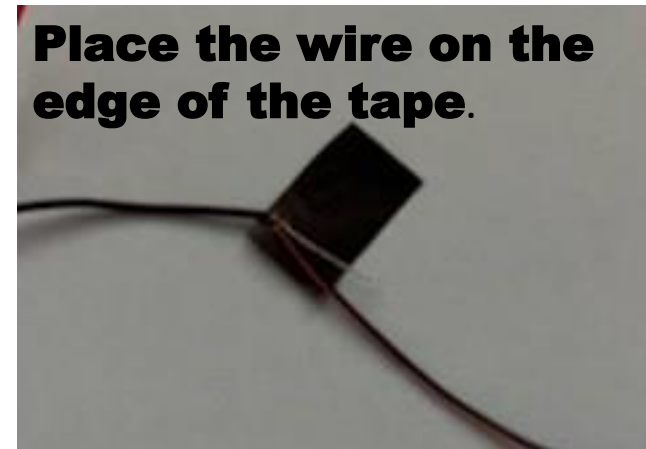


Let's Fly a Drone (Grades 4 and 5)

STEP Three: Connecting Motor Wires

(Group A)

- Straighten out the wires so the **black power wire** and the **black motor wires** make a line.
- Fold the wires over until they lie on top of the **black power wire**.
- Take one of the pieces of electrical tape. Make sure the sticky side is facing up.
- Set the wires on the edge of the electrical tape.
- Wrap the tape around the wires and pinch it to make sure it is secure.

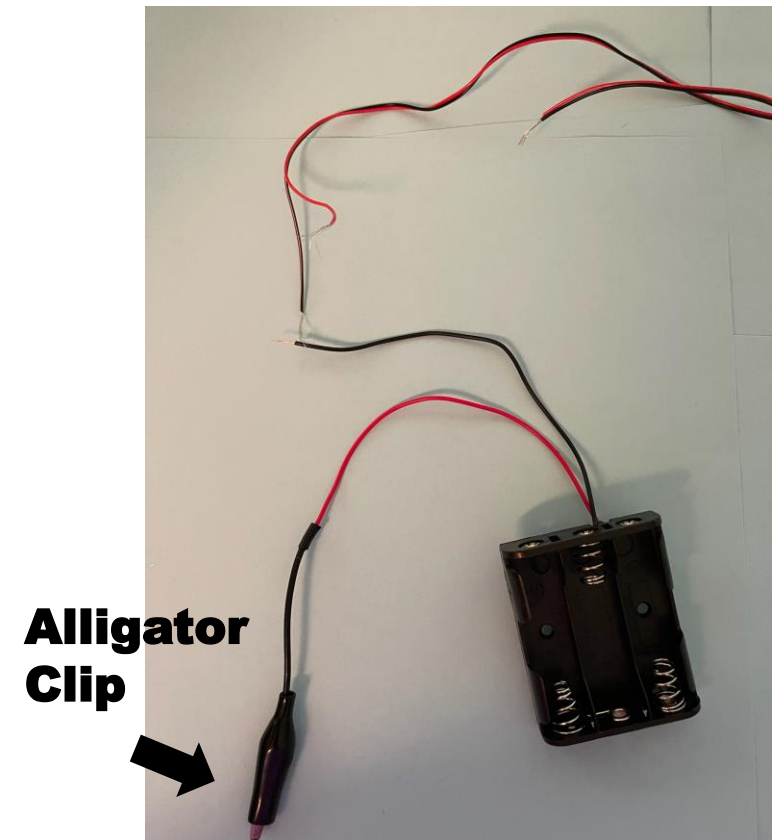


Let's Fly a Drone (Grades 4 and 5)

STEP Four: Connecting Motor Wires to the Battery Pack

- Take your battery pack out of the bag.
- Connect the **black wires** together.
- Do not connect the **red power wire**.

Note: The alligator clip will serve as the on/off switch for your drone.



Let's Fly a Drone (Grades 4 and 5)

STEP Four: Connecting Motor Wires to the Battery Pack

- Twist the wires together.
- Straighten out the wires so they make a line.
- Fold the twisted wires over until they lie on top of the black wire.
- Take one of the pieces of electrical tape. Make sure the sticky side is facing up.
- Set the wires on the edge of the electrical tape.
- Wrap the tape around the wires and pinch it to make sure it is secure.



Let's Fly a Drone (Grades 4 and 5)

STEP Five: Putting Batteries in Battery Pack

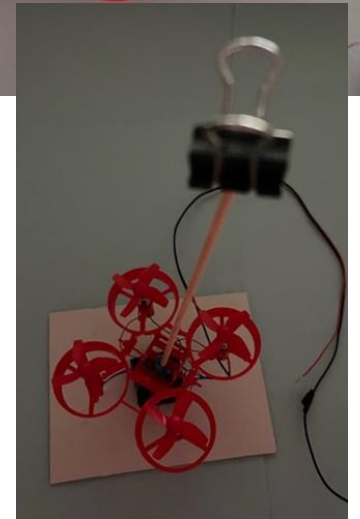
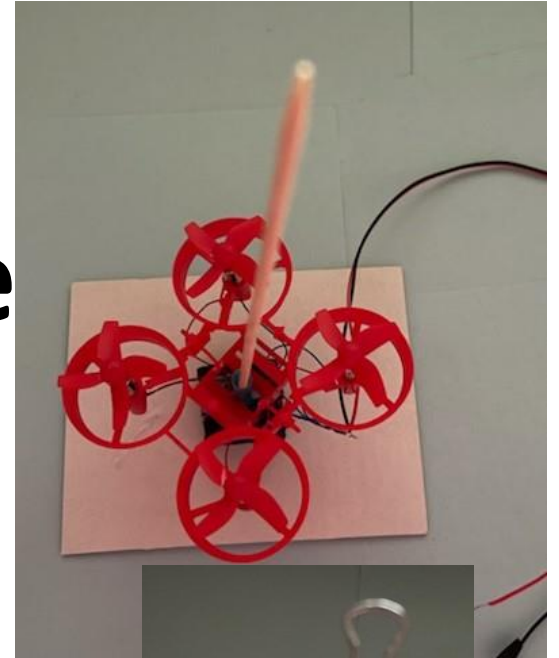
- You have 3 batteries to put in your battery pack. This is a short video that explains the process.
- The video demonstrates putting batteries into a remote control.
- The same process applies to putting batteries into your battery holder.
- <https://www.youtube.com/watch?v=UjpRNGs6GCI>



Let's Fly a Drone (Grades 4 and 5)

STEP Six: Operating Your Drone

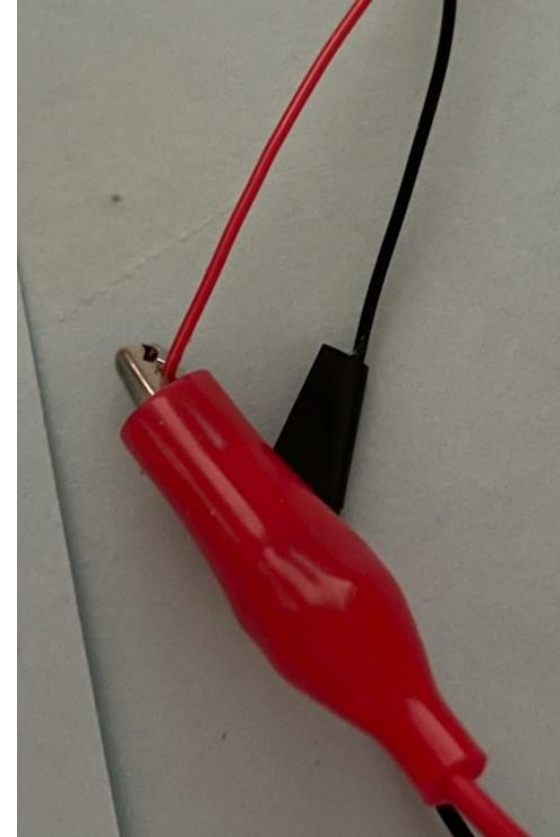
- Take your drone and **CAREFULLY** place the skewer on the base through the straw on the drone body.
- Make sure the side with the propellers/rotors is facing up.
Attach the end cap to the top of the skewer.



Let's Fly a Drone (Grades 4 and 5)

STEP Six: Operating Your Drone

- Straighten out the wires so they are not twisted around the skewer.
- Take the **alligator clip** that is attached to the battery pack.
- Open the clip and connect it to the bare end of the red power wire.
- Hold down the base with one hand to make sure the drone does not tip over.
- If you have connected everything correctly, your drone will rise.



Let's Fly a Drone (Grades 4 and 5)

What You Learned Today

- **You learned the science behind drone operations and how a drone uses lift to gain altitude.**
- **You learned that “for every action there is an equal and opposite reaction” – which is Newton’s Third Law.**
- **You learned about electrical circuits and how a circuit is made.**
- **You learned how to connect wires to create a circuit.**
- **We hope you enjoyed this session as much as we enjoyed working with you today.**

