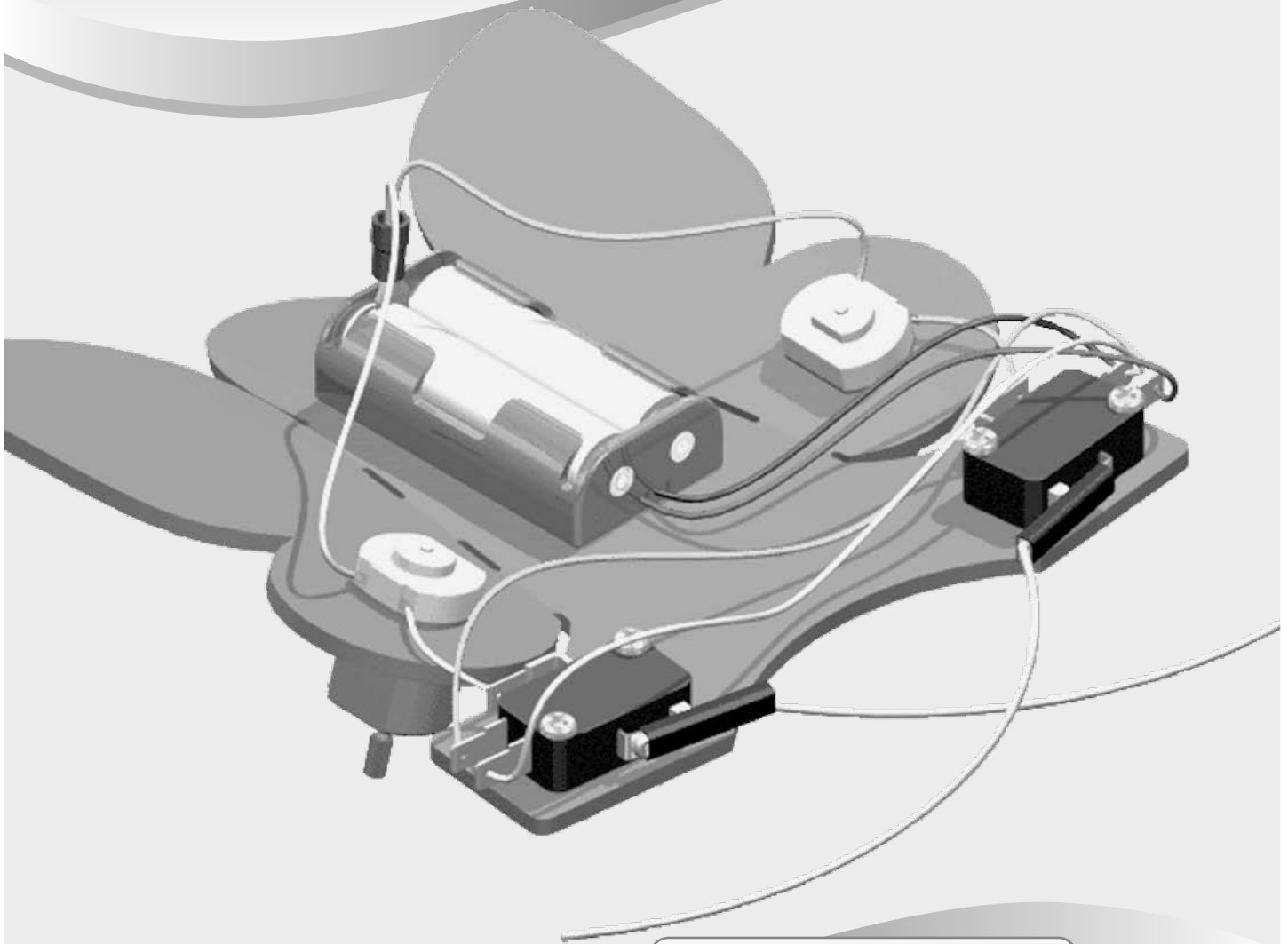


# "BUILD A BUG"

## INSTRUCTION GUIDE

(WITHOUT THE ELECTRONICS LAB)

Complete  
Bug Building  
Instructions



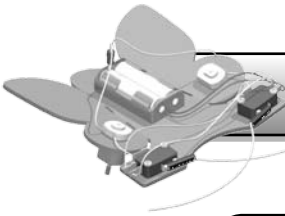
### IT'S AMAZING ...

Do you have the Bug? Turn it on and set it down. Watch it wander the floor as if it's alive; sensing objects and finding a way around them.

This document takes you through the process of building a bug. It requires the "Catch the Bug" kit from [teachergeek.com](http://teachergeek.com).

I hope you're excited. You're going to love your bug.





# "BUILD A BUG"

## TOOLS NEEDED



Crimper/Wire Stripper



Pliers



Safety Glasses



Soldering Pencil and Lead-Free Solder



#1 Phillips Screwdriver

Find the perfect tools and lead-free solder at [teachergeek.com](http://teachergeek.com)

The bug body needs to be heated for bending. Many heat sources will work for this:



Strip Heater

or

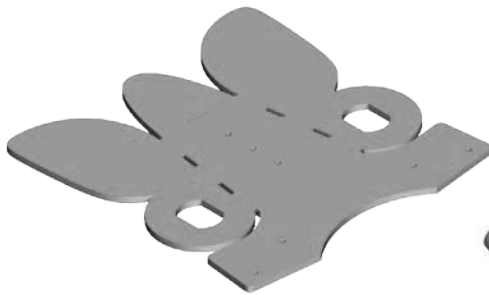


Blow Dryer/  
Heat Gun



Hot Water (run hot water over bug)

## BUG PARTS (PARTS TO BUILD 1 BUG)



1- Bug Body



2- Snap Action Switches



2- Motors



1- Spade Connector



4- Long Screws



1- Battery Pack



1/2" (~14mm)-  
Tire Material



2- Short Screws

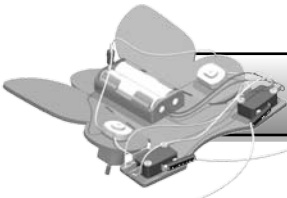


2" (~50mm)-  
Blue Tubing



18"- (45cm) Twisted Wire

2- Steel Feeler Wires



# "BUILD A BUG"



Your Bug Body is made of recycled polypropylene plastic. See how it was injection molded in the [teachergeek.com](http://teachergeek.com) forum.



## A. BEND THE BODY

The Bug Body must be heated for bending. Here are some options:



Adult Supervision Required  
Be Careful of Burns



Strip Heater



Blow Dryer

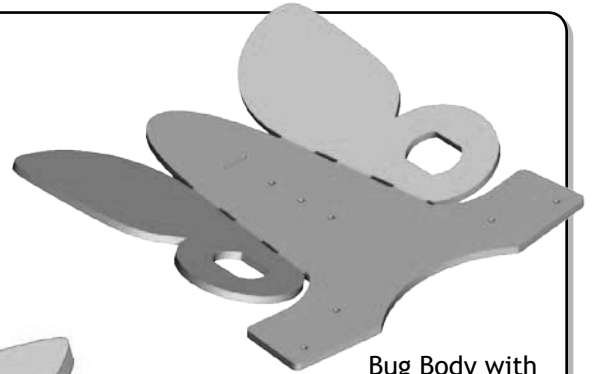


Hot Water (run hot water over bug)

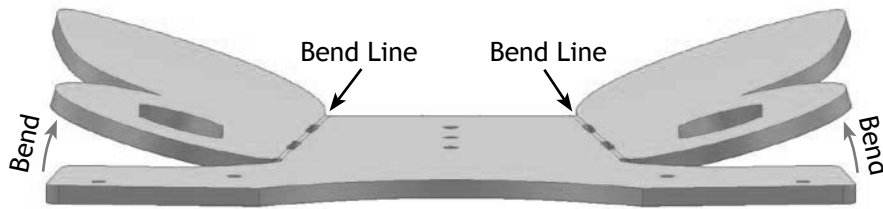
## BEND THE WINGS UP

Bend one wing at a time:

1. Apply heat to the wing's bend line until it becomes slightly more flexible (don't wait for it to melt or droop).
2. Bend the wing upwards (about 15 degrees).
3. Hold the wing in the bent position until it cools.

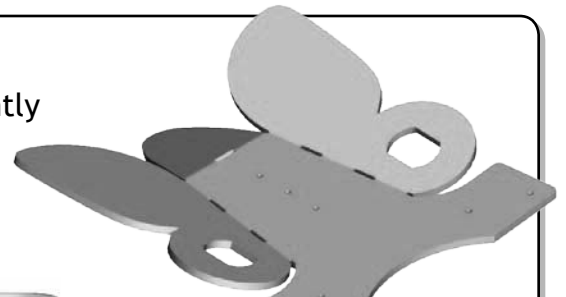


Bug Body with Bent Wings

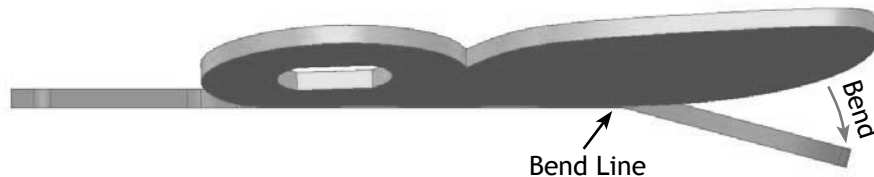


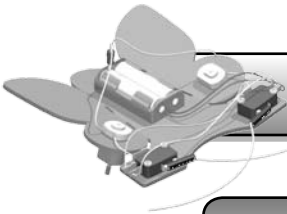
## BEND THE TAIL DOWN

4. Apply heat to the tail's bend line until it becomes slightly more flexible (don't wait for it to melt or droop).
5. Bend the tail downwards (about 15 degrees).
6. Hold the tail in the bent position until it cools.

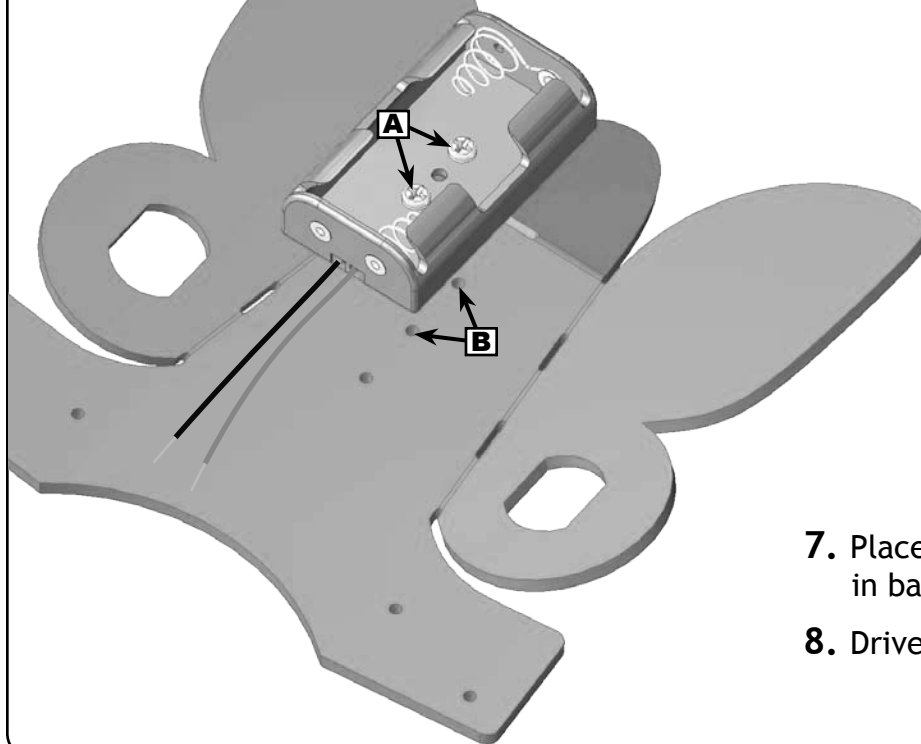


Bug Body with Bent Wings and Bent Tail








## B. ATTACH THE BATTERY HOLDER

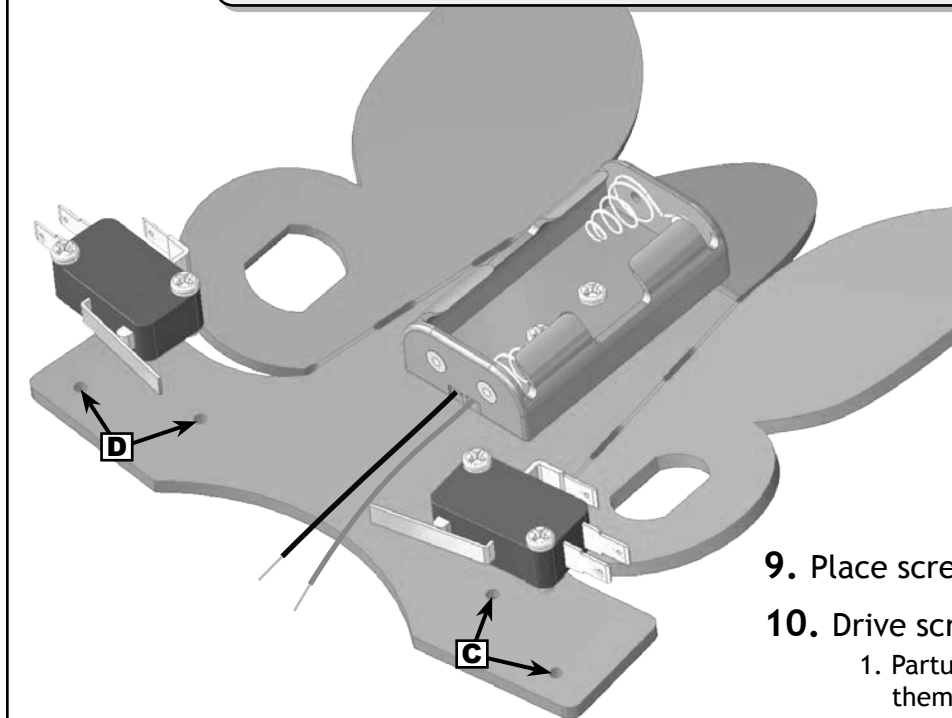


### WHAT IS NEEDED?

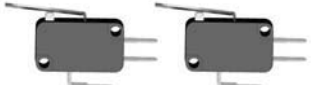


-  2 Short Screws
-  1 Battery Holder
-  #1 Phillips Screwdriver

7. Place screws into holes **A** in battery holder.
8. Drive screws into holes **B**.

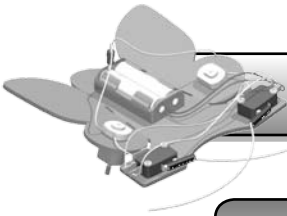
## C. ATTACH THE SWITCHES



### WHAT IS NEEDED?

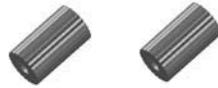
-  2 Switches
-  4 Long Screws
-  #1 Phillips Screwdriver

9. Place screws into switches (as shown).
10. Drive screws into holes **C** and **D**.
  1. Partly drive in all screws (leaving them loose)
  2. Tighten all screws



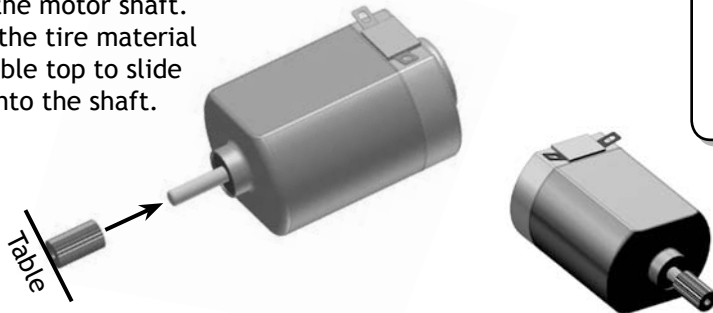
## D. PUT THE "TIRES" ON

**11.** Cut two 1/4" (7mm) sections of tire material. Make sure cuts are straight.



**12.** Place one section of tire material onto each motor shaft

Get the tire material started on the motor shaft. Then press the tire material against a table top to slide it further onto the shaft.



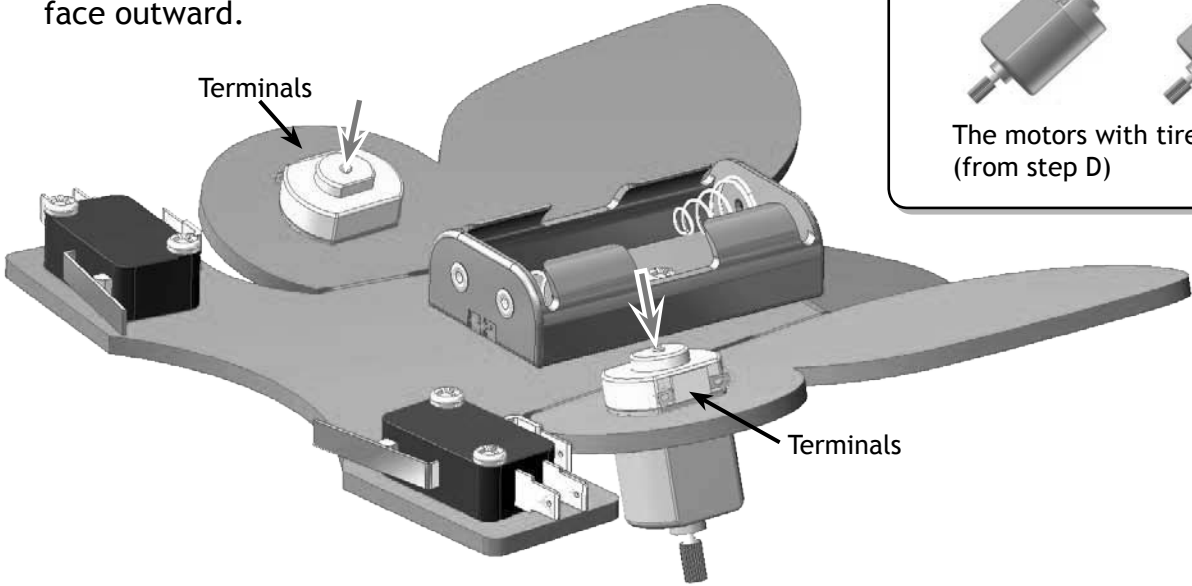
**WHAT IS NEEDED?**

2 Motors      1/2" (~14mm) Tire Material

A Cutting Tool      Cutting Blade

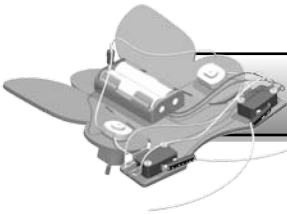
## E. ATTACH THE MOTORS

**13.** Push the motors down into the bug body so the copper terminals face outward.



**WHAT IS NEEDED?**

The motors with tire material (from step D)

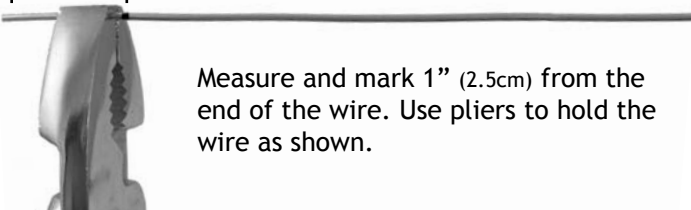


## F. BEND THE FEELERS

14. Create 2 feelers using this process:

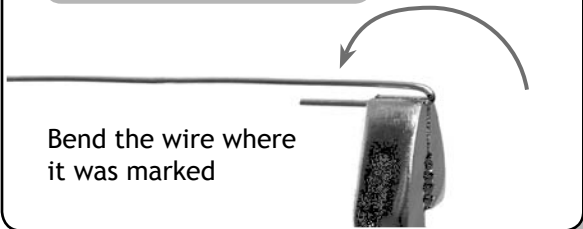
### 1. MEASURE, MARK, HOLD

1"  
(2.5cm)



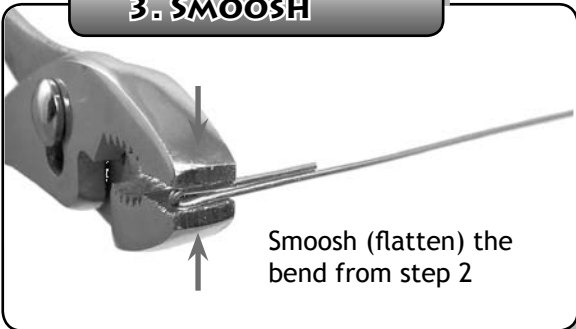
Measure and mark 1" (2.5cm) from the end of the wire. Use pliers to hold the wire as shown.

### 2. BEND



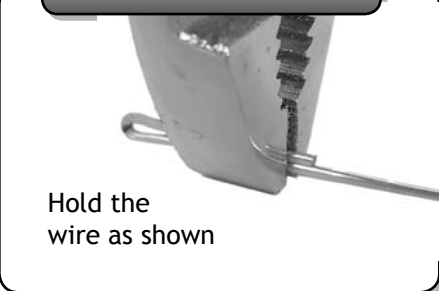
Bend the wire where it was marked

### 3. SMOOSH



Smoosh (flatten) the bend from step 2

### 4. HOLD



Hold the wire as shown

### WHAT'S NEEDED?



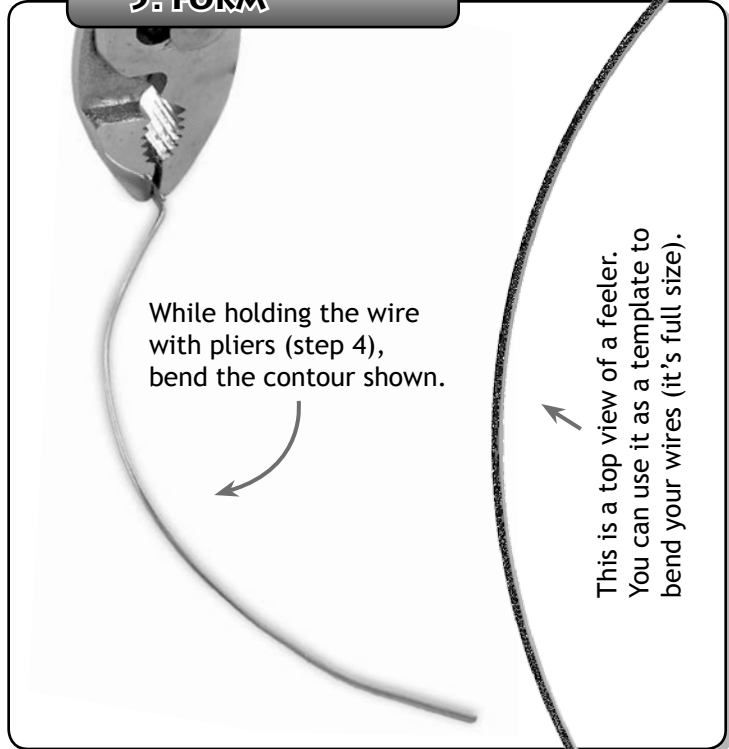
Marker



Pliers

2 Steel Feeler Wires

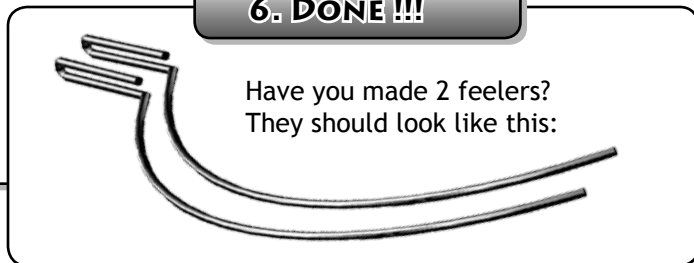
### 5. FORM



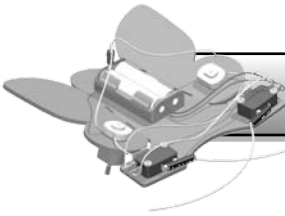
While holding the wire with pliers (step 4), bend the contour shown.

This is a top view of a feeler. You can use it as a template to bend your wires (it's full size).

### 6. DONE !!!



Have you made 2 feelers? They should look like this:



## G. ATTACH THE FEELERS

15. Cut two 1" (2.5cm) sections of blue tubing.

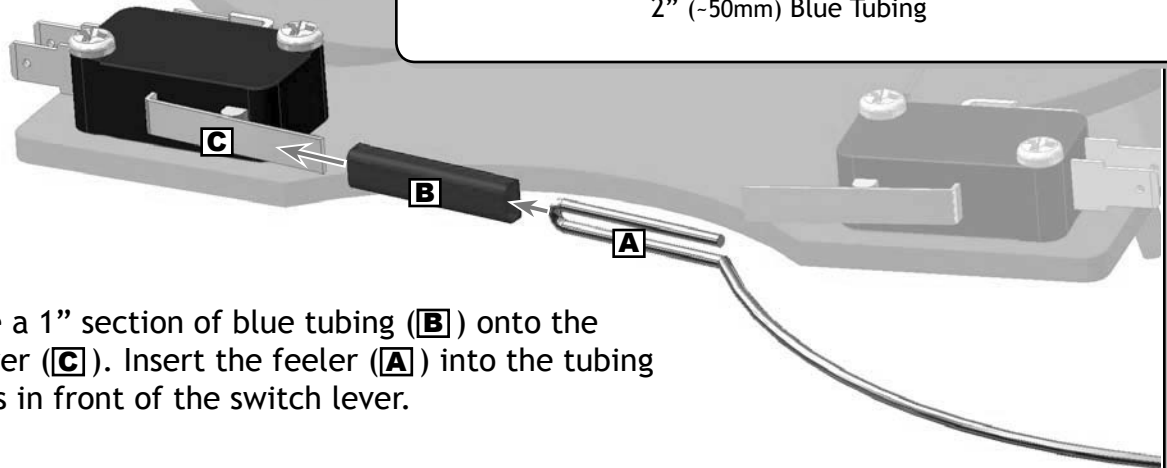


WHAT'S NEEDED?

The feelers from Step F

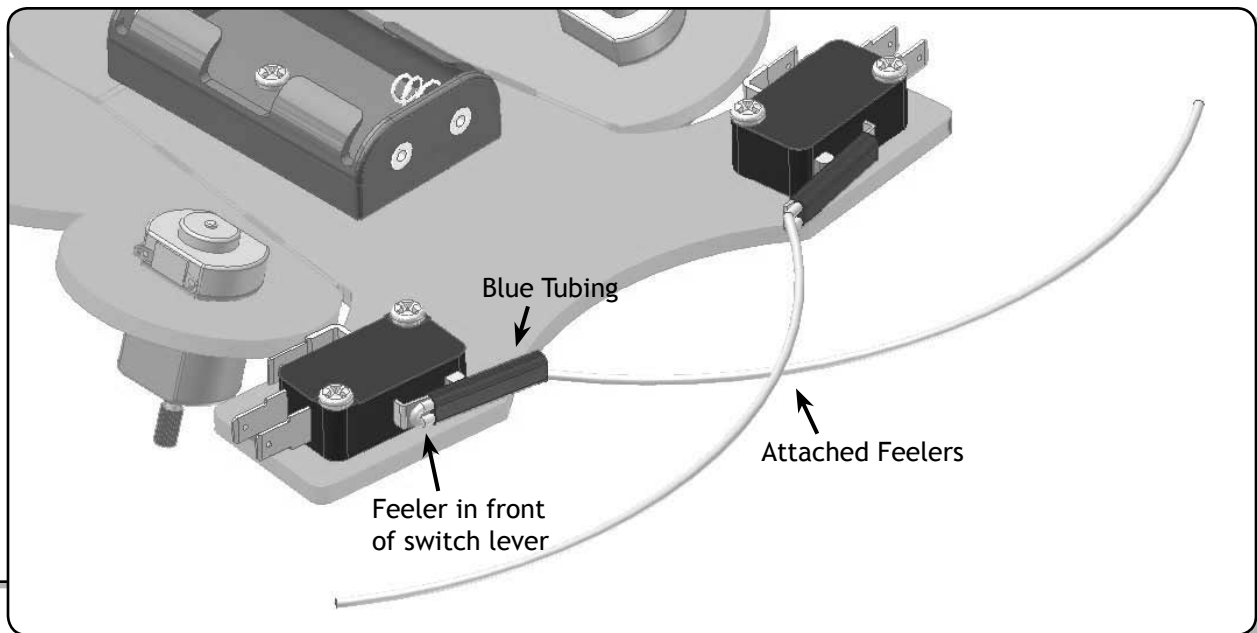
A Cutting Tool

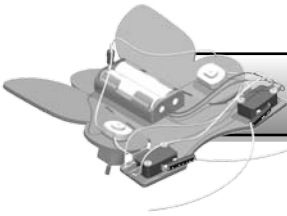
2" (-50mm) Blue Tubing



16. Place a 1" section of blue tubing (**B**) onto the switch lever (**C**). Insert the feeler (**A**) into the tubing so it slides in front of the switch lever.

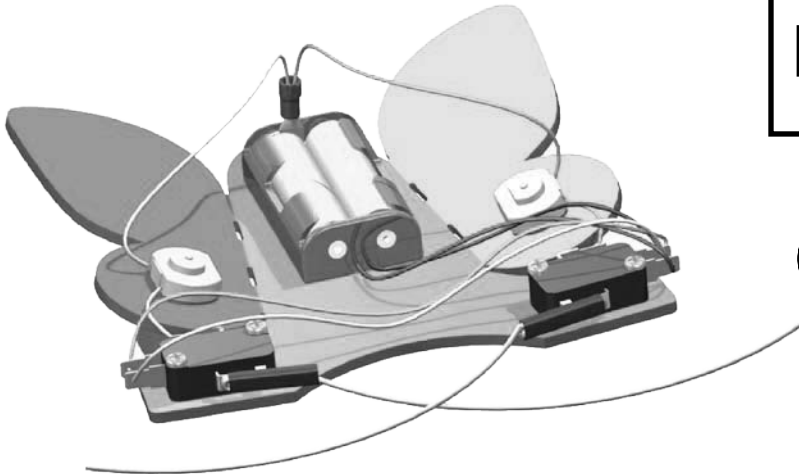
17. Repeat the process to attach the second feeler.



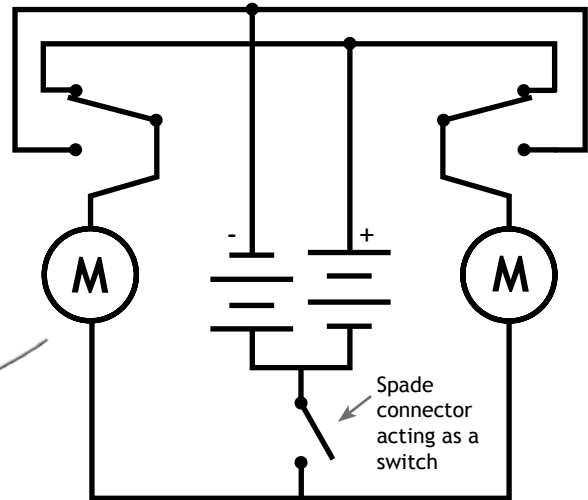


## LET'S WIRE

You're bug will look something like this then it's wired:

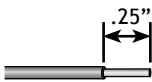


Schematic of your final wiring:



## TIPS AND TRICKS

Strip .25" (6mm) of insulation from the ends of wires (before connecting them).



Twist together the stranded ends of wires.

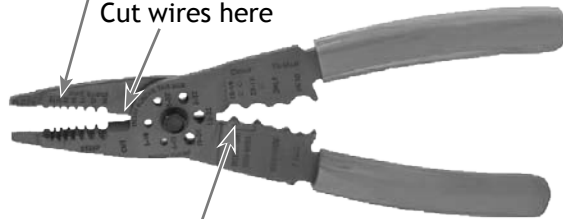


Hold-off on soldering until all the wires have been put on your bug.



Hook wires through terminal holes, then pinch (smoosh hooked wire) to secure.

Strip wires here  
Cut wires here



Crimp spade connectors here.



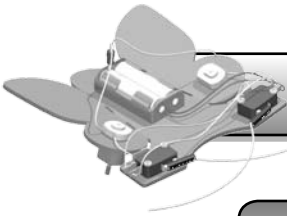
Bend out switch terminals to provide more room for wiring.



Make sure batteries are removed while wiring.



Untwist green and white wires. Use each wire separately.



## THE HARNESS

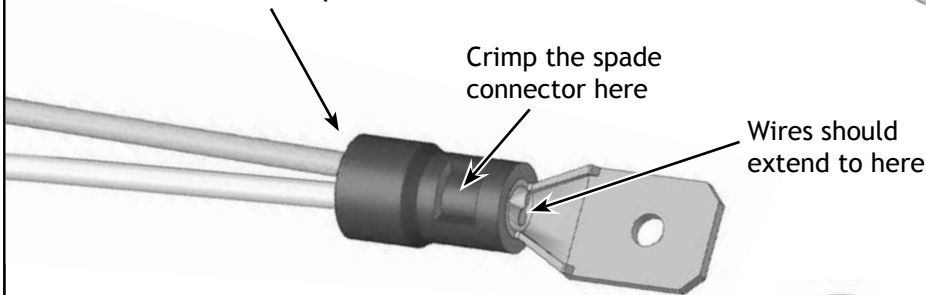
1. Cut two 5.5" (14cm) wires (any color).

2. Strip the wire ends.

3. Twist the wires together (at one end).

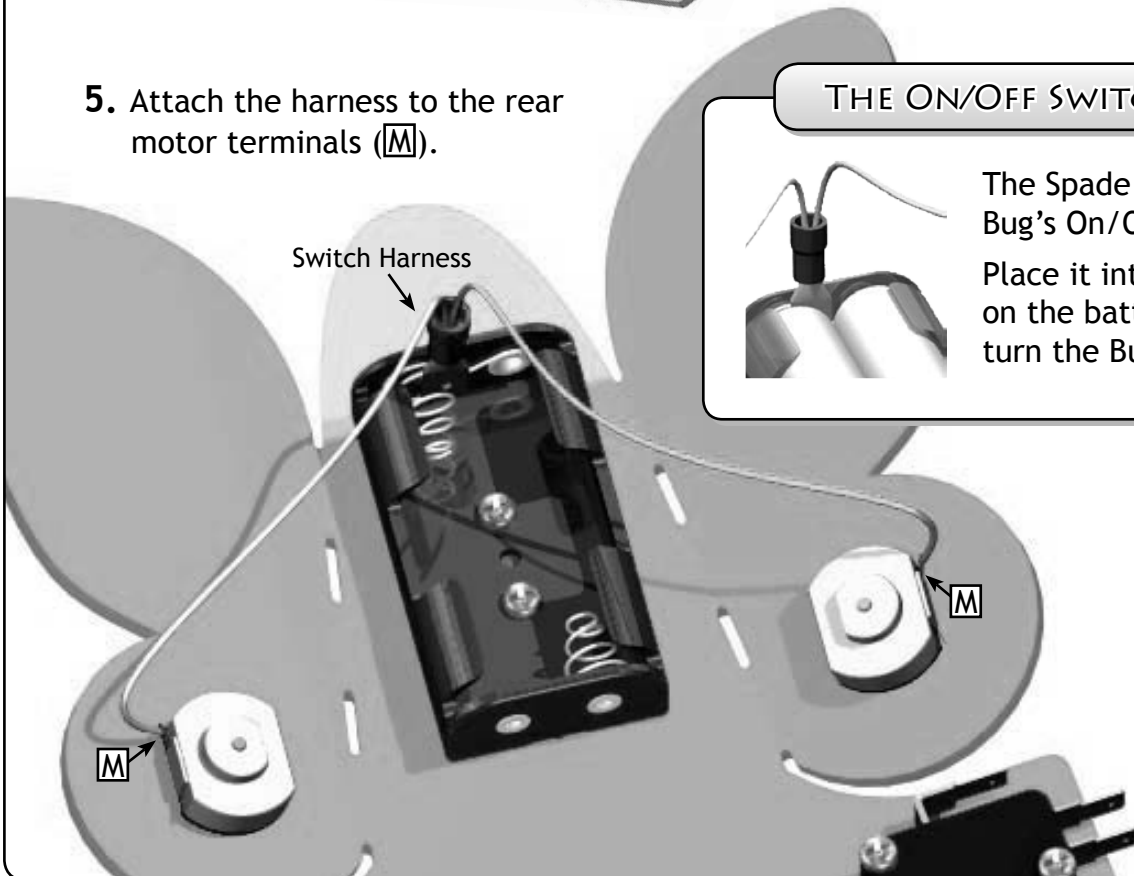


4. Place the twisted end of the wires into a spade connector.



Finished Harness

5. Attach the harness to the rear motor terminals (M).

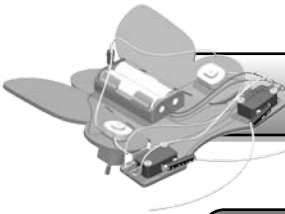


## THE ON/OFF SWITCH



The Spade connector is the Bug's On/Off Switch.

Place it into the rear spring on the battery holder to turn the Bug on.



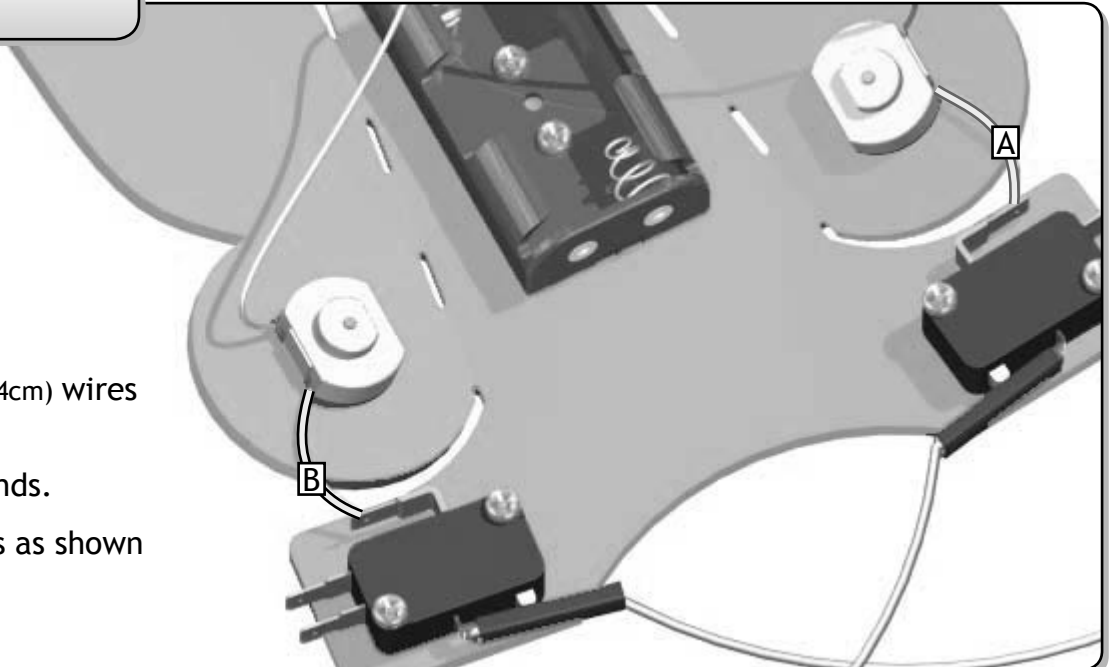
# "BUILD A BUG"

## STEP-BY-STEP WIRING

Wire your bug in three steps (4 including soldering).

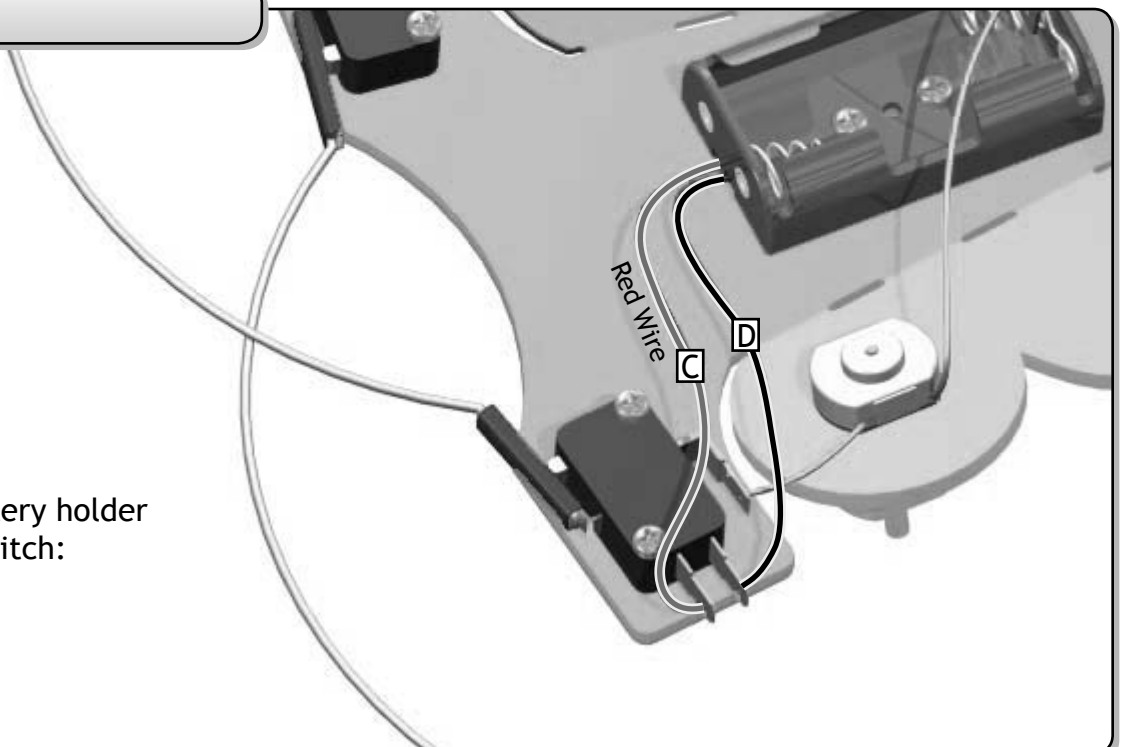
### STEP 1

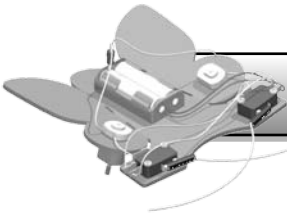
1. Cut two 2.5" (6.4cm) wires (any color).
2. Strip the wire ends.
3. Attach the wires as shown with **A** and **B**.



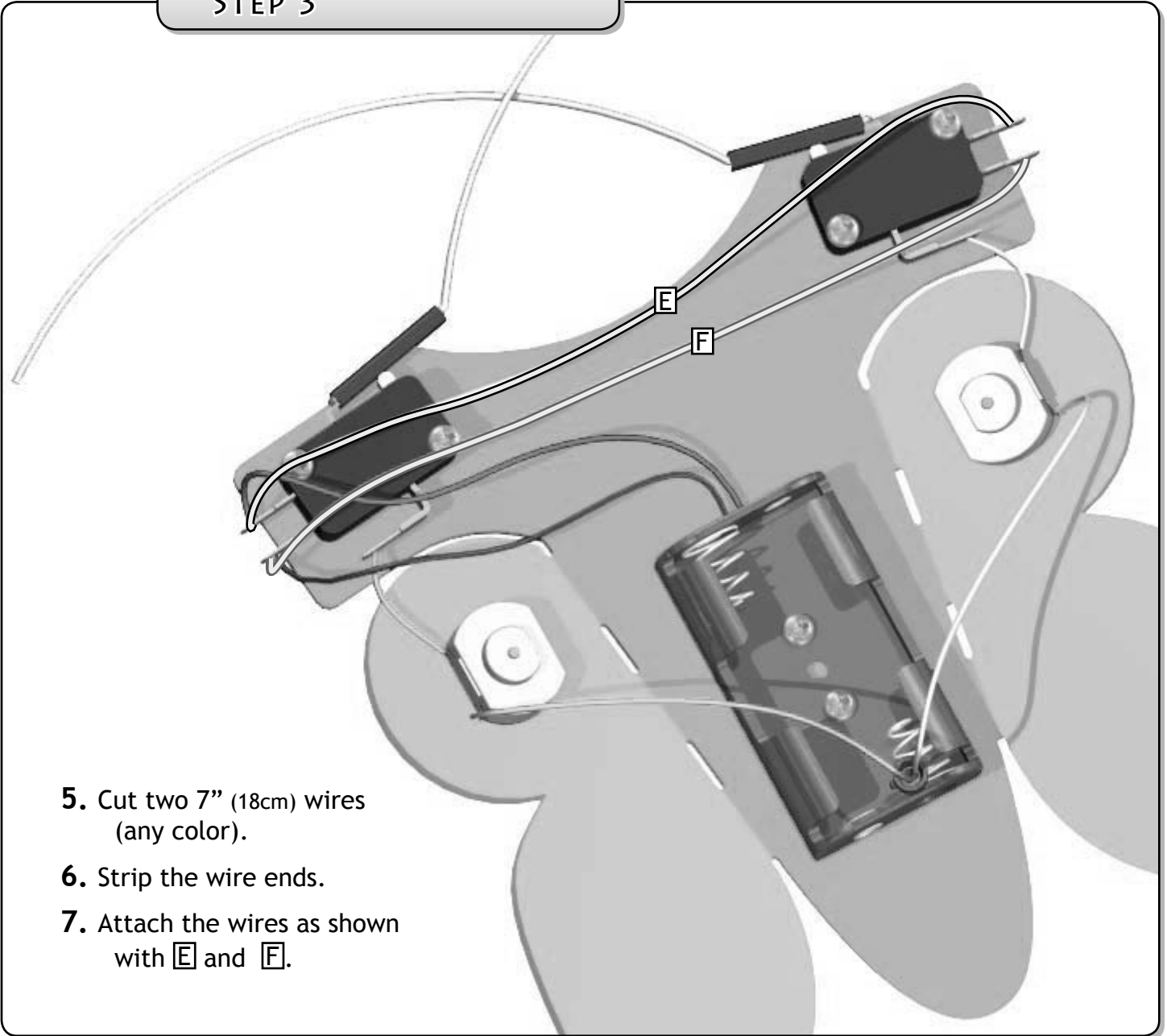
### STEP 2

4. Attach the battery holder wires to the switch:  
**C** = red wire  
**D** = black wire



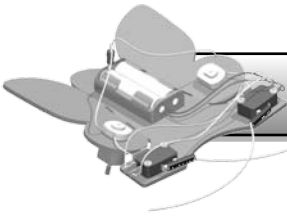


## STEP 3



5. Cut two 7" (18cm) wires (any color).
6. Strip the wire ends.
7. Attach the wires as shown with **E** and **F**.

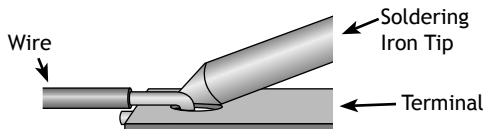
It's time to solder. See page 12 for instructions.



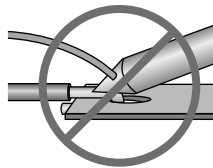
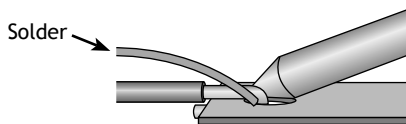
## HOW TO SOLDER

WHEN ELSE DO YOU GET TO MELT METAL?

1. Place the tip of the soldering iron firmly against the wire and terminal.

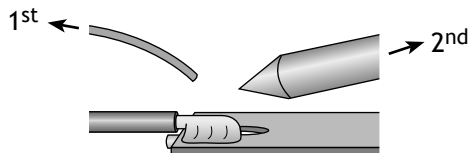


2. Push the solder in between the terminal, wire and soldering iron.

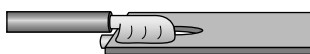


Pushing the solder directly onto the soldering iron tip will cause a bad solder joint.

3. Add solder until a thin coating flows over and between components. Pull the solder away, followed by the the soldering iron.

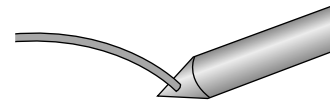


4. Do not move the components until the solder has cooled.



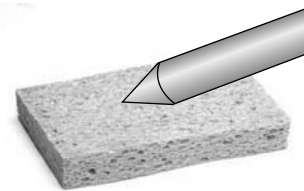
Adult Supervision Required.  
Be Careful of Burns.  
Wear Safety Glasses.

## TIP TIPS (SOLDERING IRON TIPS)



**Tin the Tip:** Lightly coat the tip with solder before and after use.

The tip is coated in iron (which rusts). Tinning it after you finish will protect it from rusting. Tinning it before use will help it conduct heat.



**Shiny Tips Work Better:** Keep the tip clean by wiping it from time to time on a damp sponge.

## GOOD SOLDER JOINT

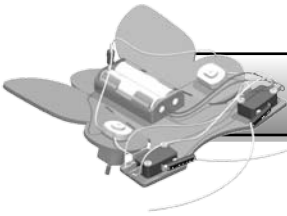


Solder flows over and between components.

## BAD SOLDER JOINT



Solder forms as a ball. Fix by applying heat with the soldering iron until solder flows between components.



## TROUBLESHOOTING GUIDE

### **Problem: Batteries become hot**

Culprit: The circuit has a short circuit (bad wiring, or bridged solder joints).

Fix: Quick!!! Turn off the Bug and remove the batteries. Check the wiring.

### **Problem: Bug turns instead of going straight**

Note: Bugs will usually turn slightly because, in order for them to go forward, one motor is turning forwards while the other is turning in reverse. The motors used on the Bug have slightly greater speed and torque when turning forwards. You can adjust for this by moving the motors up or down in the bug body.

Culprit 1: The Bug will turn if the wings are bent at different angles.

Fix: Reheat and re-bend the wings.

Culprit 2: Tire Rubber was cut at an angle or uneven.

Fix: Trim the tire rubber so the end is straight (perpendicular with the hole).

Culprit 3: The tire material is pushed up tight against the motor housing, or up to high on the motor shaft

Fix: Slide the tire material so that it extends slightly past the motor shaft, and away from the motor housing.

Culprit 4: Something is wrapped around your motor shaft or tire.

Fix: Clean it.

Culprit 5: Bad soldering, or lack of soldering.

Fix: Make sure all connections have been soldered. A non-soldered connection can limit the amount of electricity passing through it, causing a motor to turn slower.

### **Problem: Bug moves when it should be turned off**

Note: The Bug will reverse when the Bug is off (spade connector is removed from the battery holder spring) and the feelers are pushed. It's part of the way it was designed. We call it "playing dead."

Fix: In order to fully turn off the Bug, you must remove the batteries.

Culprit 2: The wiring is wrong.

Fix: Check the wiring.

### **Problem: Bug Bounces or Jitters when it moves**

Culprit: Tire Rubber is cut at an angle.

Fix: Trim the tire rubber so the end is straight (perpendicular with the hole).

### **Problem: Bug will not move (motors will not turn)**

Culprit 1: The batteries are dead.

Fix: Replace the batteries.

Culprit 2: The wiring is wrong.

Fix: Check the wiring.

Culprit 3: The Bug is not turned on.

Fix: Place the spade connector into the battery holder spring closest to the back of the Bug.

### **Problem: Bug will not reverse**

Culprit 1: The Bug is wired wrong.

Fix: Check the wiring.

Culprit 2: Spade connector is in the wrong side of the battery holder.

Fix: Place the spade connector into the battery holder spring closest to the back of the Bug.

### **Problem: Bug spins "on a dime" when it should go forwards**

Culprit 1: Motors are wired backwards and/or put in upside-down.

Fix: Make sure the motor terminals are on the outside of the Bug.

Check the wiring.