

**GEEK  
& CO.  
SCIENCE!**



PROJECT KIT **Ages  
8+**

# BUILD YOUR OWN FLYING ORNITHOPTERS

**THAMES & KOSMOS**



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| 6  | Ball joint                      | 19 | Bamboo dowels, 135 mm (4)    |
| 7  | Left sector gear                | 20 | Bamboo dowels, 220 mm (6)    |
| 8  | Right sector gear               | 21 | Double-sided tape sheets (2) |
| 9  | Ratchet socket                  | 22 | Protective sticker sheet     |
| 10 | Snail cam lever                 | 23 | Sandpaper piece              |
| 11 | Triangle empennage (tail frame) | 24 | Part separator tool          |
| 12 | V-shaped connector              | 25 | Rubber bands (6)             |
| 13 | Triangle frame                  |    |                              |

**YOU WILL ALSO NEED:** A “test flying” area at least 30 meters (about 100 feet) long

## Hey Flight Fanatics!

Are you ready to build four awesome rubber band powered flying ornithopters, learn how insects and birds fly, and how wings generate lift? Let’s get started! With this kit you can build a mechanical flying bird, bat, butterfly, and dragonfly. Helo the Geeker will be your guide!



# PART 3

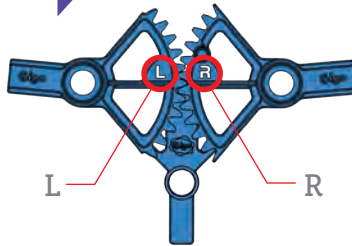
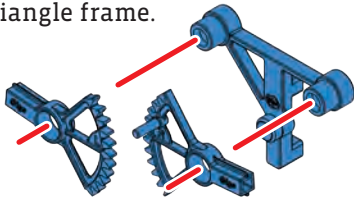
# ANOTHER PAIR OF WINGS

More wings  
please!



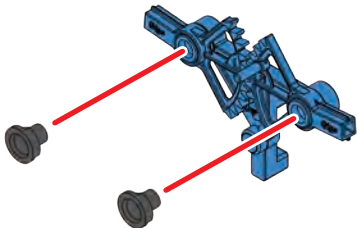
## Model 4: Dragonfly

- 1 Put the sector gears onto the triangle frame.

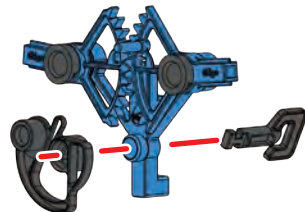


The left sector gear and right sector gear should be lined up evenly like this.

- 2 Put the tube bolt caps on the fronts of the sector gears.



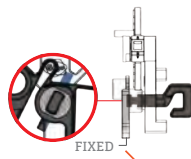
- 3 Attach the hook by inserting it into the snail cam and then turning it 90 degrees. Pay attention to the hook direction!



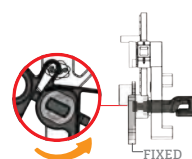
Side view



Push hook all the way in.

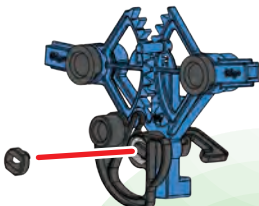


Pull hook back 1 mm.

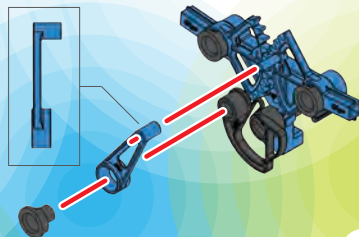


Turn the hook 90°

- 4 Attach a mortise cap to hold the hook in place.

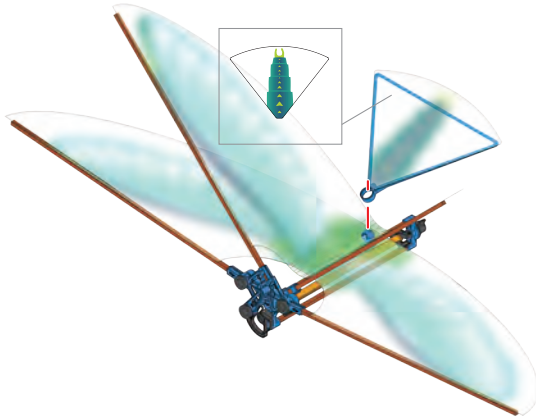
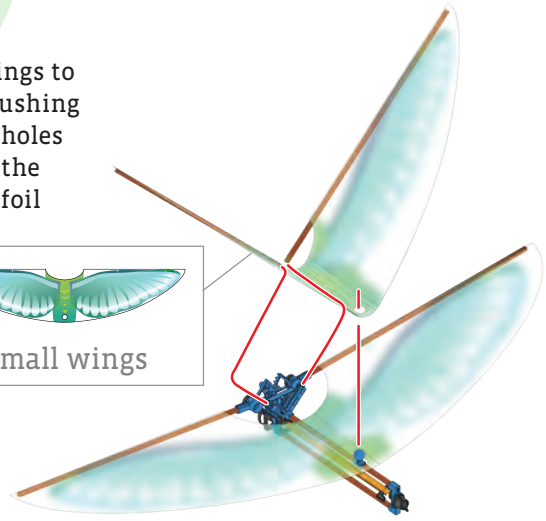


- 5 Attach the snail cam lever with a tube bolt cap.



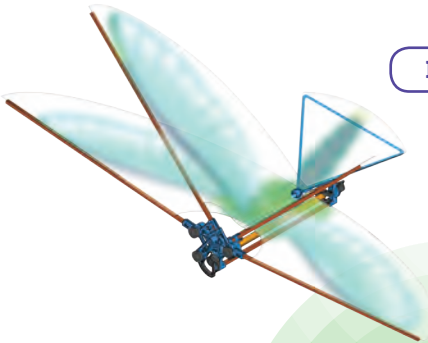
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- 10** Attach the smaller pair of wings to the V-shaped connector by pushing the bamboo dowels into the holes in the connector. Then push the hole in the back of the wing foil over the ball joint.

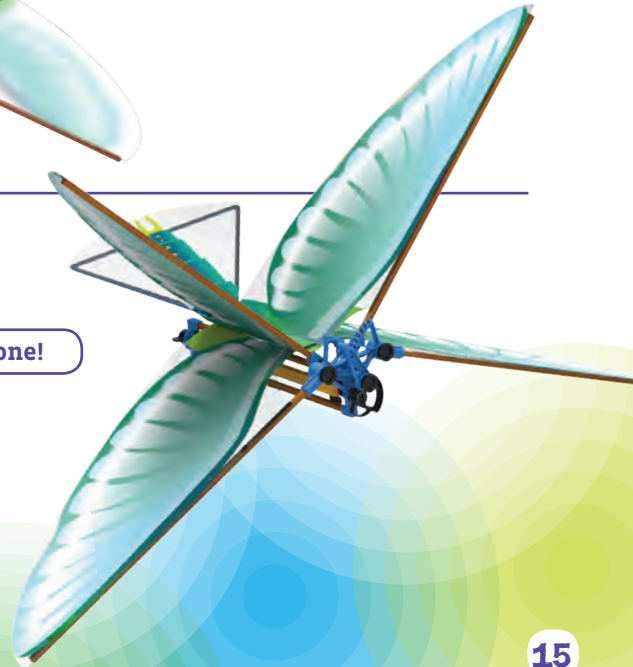


- 11** Attach the tail to the ball joint. Position the tail with its back angled upward.

- 12** Follow the flying instructions on page 6.



Done!



**GEEK  
OUT!**

# ALL ABOUT INSECT WINGS

These are  
what I call  
"buzz words!"



Insects are the only group of invertebrates, or animals that do not possess a vertebra or backbone, that evolved wings and flight.

The muscles that dragonflies use to fly are attached directly to their wings. They insert directly at the base of the wing and are hinged so that a small movement of the wing base produces a large movement of the whole wing. This motion is much like rowing. The front and back sets of wings operate independently, allowing for more maneuverability. This adaptation enables dragonflies to be effective predators.



Because the flight muscles of dragonflies are directly attached to their wings, this method of flight is called **direct flight**. Direct flight is only found in insects belonging to the species *Odonata*, which include dragonflies and damselflies. All other winged insects use a method of flying called **indirect flight**.

In indirect flight, the flight muscles attach to the thorax, or the middle part of an insect body. When different muscles contract and relax, they stretch and compress the thorax, which moves the wings up and down!