



PROJECT N°4

Ingenuity Rotorcraft



AUTHORIZED AMA
STE(A)M PROGRAM

AGE GROUP: 5-13 ADVANCED



PROJECT Nº4

INFO FOR PARENTS

The construction of a rubber-powered rotorcraft is simpler than that of a rubber-powered airplane, but the youngest students might still benefit from an adult's help. The template that is included here will need to be cut out precisely in order to create the box, which may require adult assistance. The AMA Jr. Camp Flight Kits include pre-cut templates, making this project much simpler. Adults may need to assist with winding and launching.

OBJECTIVES

Fine motor skills: The building process involves manipulating materials and intricately connecting flexible and solid materials.

Problem solving: The presence of torque adds a complicating factor to what students might expect to see during testing and produces a critical thinking challenge.

Hypothesis: Discuss how you think this aircraft will fly. What forces will be acting on the fuselage? The propeller? Why do you think the Ingenuity helicopter on Mars has two rotors at the top?

BACKGROUND INFORMATION

Aircraft that are powered by rotors, such as helicopters, are much more complex than fixed-wing aircraft, such as airplanes. Even so, the physical principles at work are much the same. A rotorcraft still must generate lift to overcome the force of gravity or weight. While an airplane needs to move forward at a fast enough speed for its wings to create that lift from the air flowing over them, a rotorcraft simply spins its rotor blades to create that same force.

While the blades create lift, their rotation generates another force called torque. Because every action causes an equal and opposite reaction, when a propeller spins one direction, the stick will naturally spin the other. We counteracted this force by adding the paper cube that wraps around the balsa stick. What other ways could we have counteracted this counter-rotational force? Why do you think the Ingenuity aircraft uses two propellers?

SAFETY TIPS

Launching rubber-powered models usually works best when the propeller/rotor is released a second or two before the entire model is launched, and a gentle push in the direction you wish the model to go can be a big help.

Make sure the rubber band and rotor blades are far away from anything they could get tangled in, such as long hair or electrical cables.

After you have successfully flown your model multiple times, try adding more winds to the rubber. Be careful not to snap it but try to predict the effect that more or fewer winds will have on its performance. Will you need a bigger or smaller stabilizer? Why?

SUPPLIES NEEDED

1 propeller assembly

die-cut template

Rubber band

Balsa motor stick (.125" x 3.75" x ~7")

Masking Tape (3")

Tools Needed if cutting out your own template:

Printed template

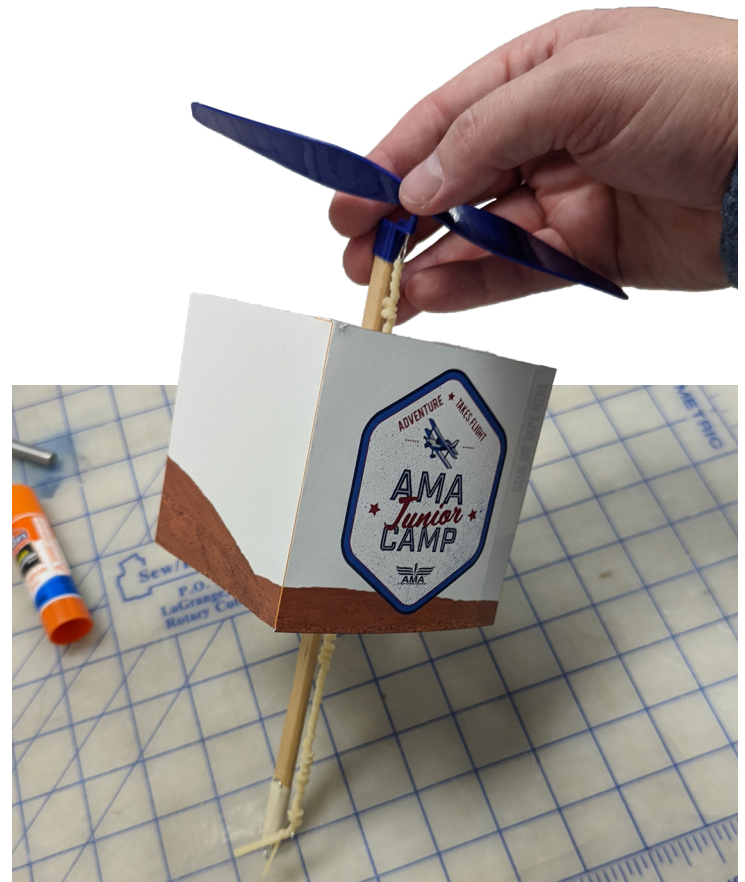
Good scissors

X-acto style knife (use only under close supervision!)

Cutting board

Straight edge/metal ruler

Tape or glue stick





Ingenuity Rotorcraft

INSTRUCTIONS

(If building from the AMA Jr. Camp Kits die-cut piece, skip to step 5.)

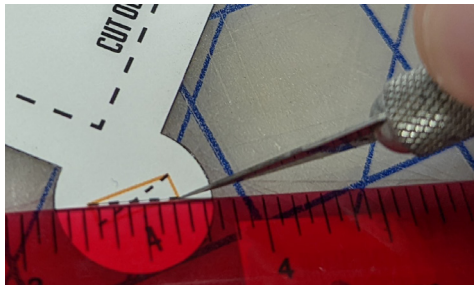
1. Print off the template sheet onto an 11x17 piece of paper.



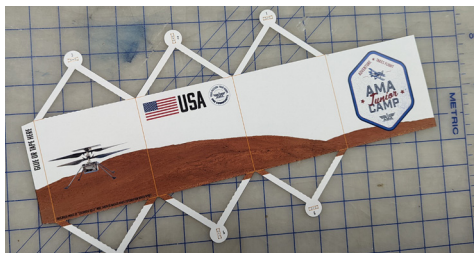
2. Using a good pair of scissors, cut out the templates solid outer edges.



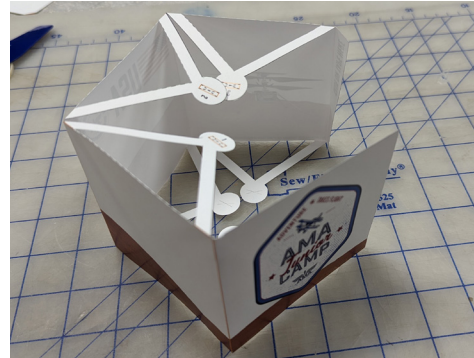
3. Inside the outer circles, cut straight lines across the dotted lines, in an "X" pattern.



4. Cut out the inner dashed line triangles.



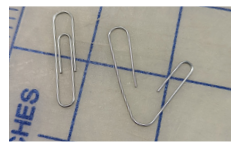
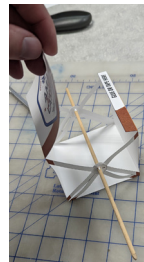
5. Fold along the orange lines



6. Take the balsa shaft and gently insert into slot one. Continue the process gently inserting the balsa stick from 1-3.



7. While gently holding the paper slots 1-3 together, slide the balsa stick to the next set of slots, 4-6, repeating the process of inserting the balsa stick leaving approximately 1" of stick protruding past the top slots (1-3).



8. Bend your paperclip so it resembles the image shown.

9. Using your masking tape, affix the paperclip to the bottom of the balsa shaft. Ensure that the paperclip points towards the section of the above box with the AMA Jr. Camp icon.



10. Place the propeller assembly onto the top of your balsa stick, ensuring the rubber band attachment points towards the AMA Jr. Camp logo.



11. Slip the rubber band onto the hook of the propeller and the paperclip. (As the rubber band is wound, it will store more energy that will be the power source for our model rotorcraft. When it is released, that energy will be used to spin the propeller and generate lift.) Do not over-wind it, especially for the first flight.



**HOLD
THE ROTORCRAFT
VERTICALLY
AND RELEASE!**

WHAT HAPPENED?



Academy of Model Aeronautics MODEL AVIATION STUDENT CLUB

IT'S **STE(A)M**
EDUCATION
THAT'S **FUN!**

The Academy of Model Aeronautics is a world-class association of modelers organized for the purpose of promotion, development, education, advancement, and safeguarding of modeling activities. In 2011, AMA established the Model Aviation Student Club (MASC) program that provides school aeromodeling clubs a means to charter their group with the organization. Form a MASC through your middle school, high school, homeschool group, or Scouts!



- ✕ Use model aviation as an interactive method of learning about science, technology, engineering, art, and math (STE(A)M).
- ✕ Learn how model aviation can transform from hobby to career!
- ✕ The MASC group leader receives a full AMA membership—including a monthly issue of AMA's flagship magazine, *Model Aviation*.
- ✕ AMA youth memberships are available for \$15 per year up to age 19.
- ✕ AMA youth members receive great benefits such as insurance coverage, competition opportunities, digital *Model Aviation* magazine, and more!
- ✕ Stay connected with the model aviation industry via AMA blogs and social media.

Sign up your group today! For more information, visit amaflightschool.org/programs/masc

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