

Build It at Home: Tube Rocket & Folder Glider

Two projects made from things already in your house. The **tube rocket** is built from a paper towel roll and flies on a real rocket motor at our supervised launch day. The **folder glider** is made from a manila folder and flies right away, anywhere.

ROCKET SAFETY

Build the rocket at home, but **never put a motor in it at home**. Bring it to Church of Many Hands launch day. We provide the motor, the igniter, the fireproof wadding and the launch pad, and a grown-up does the launching.

FOUND SUPPLIES CHECKLIST

- | | |
|---|--|
| ☐ 1 paper towel tube (or 4 toilet paper tubes) | ☐ Scissors |
| ☐ 1 empty cereal box (or cracker box) | ☐ Ruler and pencil |
| ☐ 1 manila folder | ☐ 1 plastic grocery bag |
| ☐ 3 to 4 sheets of printer paper | ☐ 4 to 6 rubber bands, or 60 cm (2 ft) of string |
| ☐ White school glue | ☐ 1 drinking straw |
| ☐ Glue stick | ☐ Modeling clay (play dough or sticky tack also work) |
| ☐ Tape (masking or clear) | ☐ Markers or crayons for decorating |

PRINT THESE PAGES RIGHT

Print the template pages at **Actual size** or **100%**, not "Fit to page." Each template page has a square that should measure exactly 5 cm (2 in). Measure it with a ruler before you cut anything.

WHAT WE BRING ON LAUNCH DAY

- Rocket motor and igniter
- Flame-resistant recovery wadding
- Launch pad, rod and controller
- Safety glasses for everyone

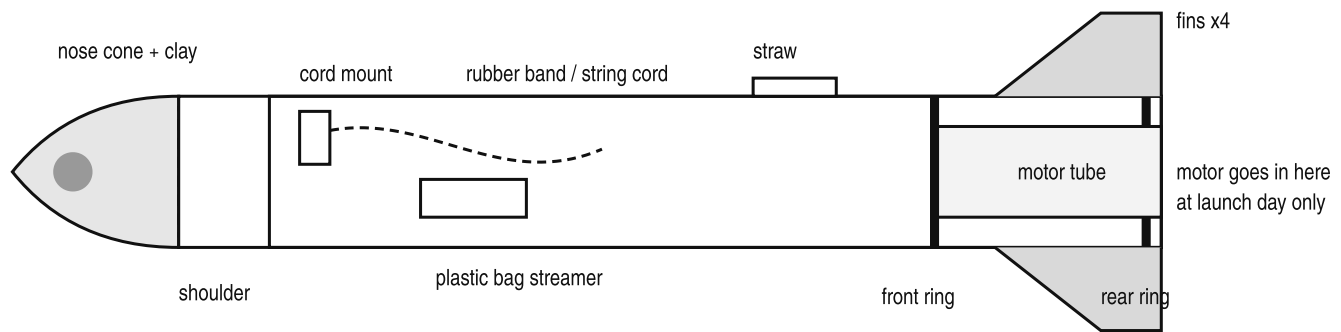
TIME

Rocket: about 2 hours plus overnight drying. Glider: about 45 minutes.

WHO CAN BUILD

Glider: ages 6 and up, with help cutting. Rocket: ages 10 and up, or younger with a grown-up helping.

How the rocket goes together



The motor sits in a small paper tube held in the middle of the big tube by two cardboard rings. The front ring has a small hole that stops the motor from sliding forward and lets its puff of gas push out the nose cone and streamer at the top of the flight.

- 1 **Cut out the templates.** Cut out Rocket Templates A and B. Trace the 4 fins onto cereal box cardboard twice each, so you have 8 pieces. Trace the nose cone and cord mount onto cereal box or cardstock.
- 2 **Make the fins stiff.** Glue the fin pieces together in pairs with white glue, printed sides facing in. Put them under a heavy book while they dry. Now you have 4 strong fins.
- 3 **Roll the motor tube.** Cut a strip of printer paper 70 mm wide. Roll it into a tube, loosen it until it slides snugly through the rear ring's hole, and tape the seam. Keep rolling the rest of the strip on with glue so the tube is 4 or 5 layers thick.
- 4 **Cut the rings.** Stand your big tube on the ring template and find the circle that fits snugly *inside* the tube. Cut 1 rear ring and 1 front ring to that size from cereal box. Cut out their center holes.
- 5 **Build the motor mount.** Glue the front ring (small hole) flat onto one end of the motor tube, like a cap. Slide the rear ring (big hole) onto the other end, about 1 cm from the end, and glue it.
- 6 **Glue in the mount.** Spread white glue on the edges of both rings. Push the mount into the bottom of the big tube, **front ring first**, until the end of the motor tube is even with the end of the big tube. Let it dry.

Using toilet paper tubes? Use 4. Three make the body. Cut the fourth in half across, slit each half along its length, roll it a little tighter, and glue it halfway inside one tube as a joiner. Slide the next tube over the other half. Your rocket body will be about 34 cm long.

- 7 **Mark the fin lines.** Use the fin spacing strip on Template A to make 4 evenly spaced marks around the bottom of the tube. Lay the tube in the corner of a door frame and draw a straight line up from each mark, about 10 cm long.
- 8 **Glue on the fins.** Put a line of white glue on a fin's root edge and press it onto a line, even with the bottom of the tube, with the slanted edge toward the nose. Hold it for a minute. Do one fin at a time and look down the tube from behind to check each fin sticks straight out. When all 4 are dry, run a bead of glue along both sides of each fin where it meets the tube and smooth it with your finger.
- 9 **Add the launch straw.** Cut a straw 50 mm long. Glue it next to one fin, halfway between that fin and the next one, about 15 cm up from the bottom. It must be perfectly straight up and down. The straw slides onto the launch rod.
- 10 **Attach the shock cord.** Loop 4 to 6 rubber bands together into a chain, or use 60 cm of string. Glue one end onto the cord mount strip, fold the strip up twice, and glue the folded mount flat inside the top of the tube, about 3 cm down.
- 11 **Make the nose cone.** Roll the cone template into a cone, slide the edge to the dashed line for your tube's width, and glue. Press the ball of clay into the tip from the inside. Roll the shoulder strip into a ring that slides easily inside your tube, tape it, and glue half of it inside the base of the cone. Tie or tape the free end of the shock cord to the shoulder.
- 12 **Make the streamer.** Cut a strip from a plastic grocery bag about 8 cm wide and 1 m long. Tape one end to the shock cord near the nose cone. To pack it, fold it back and forth like an accordion, roll it loosely, and slide it into the tube with the cord. Push the nose cone on last. It should come off with a gentle tug.
- 13 **Decorate.** Markers, crayons, stickers. Put your name on it.
- 14 **Balance check.** Tape 4 quarters to the very bottom of the rocket to stand in for a motor. Balance the rocket sideways on one finger. The balance point needs to be **24 cm or less from the tip of the nose** (for a toilet paper tube rocket, 30 cm or less). If it balances farther back, add more clay inside the nose and try again. Take the quarters off when you're done.

WHY THE CLAY?

A rocket flies straight when its balance point is in front of the spot where the air pushes on it. The big fins pull that push spot back toward the tail. The clay pulls the balance point forward. Without the clay, this fat rocket would tumble instead of flying.

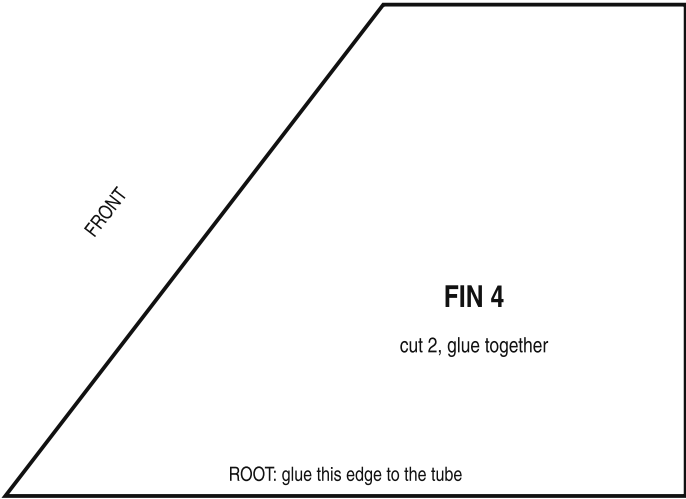
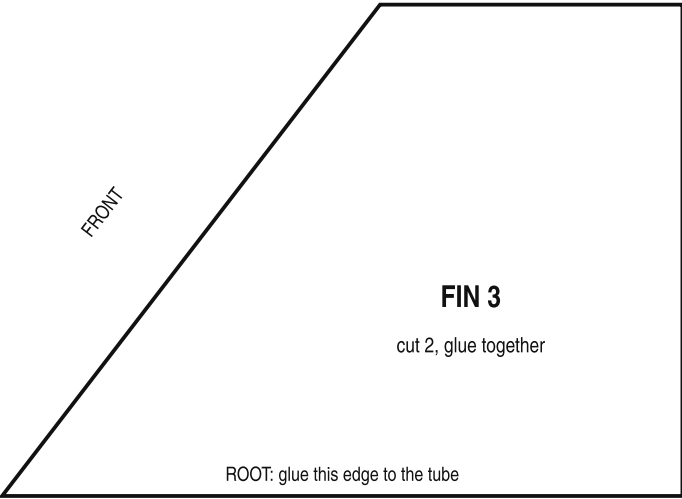
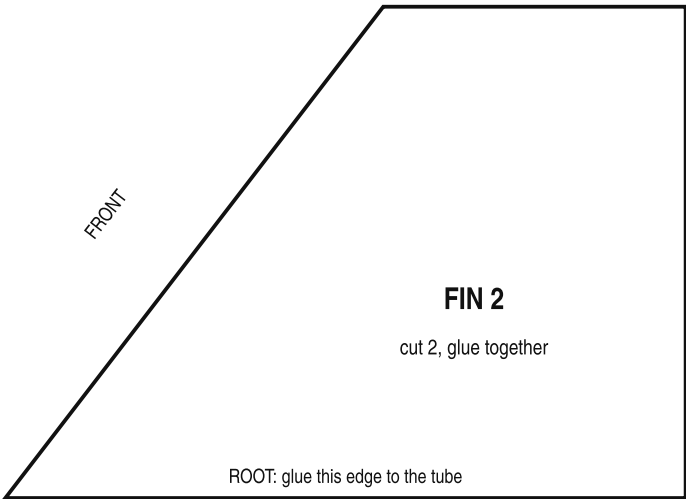
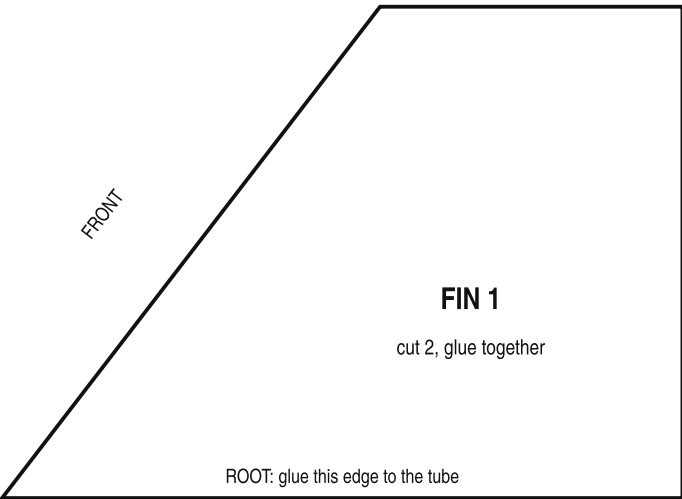
LAUNCH DAY

Bring your rocket with the streamer packed. A grown-up adds fireproof wadding, installs the motor with tape, and does the launch. This rocket is designed for **A8-3** and **B6-4** motors. On a B6-4 it goes about 90 m (300 ft) high.

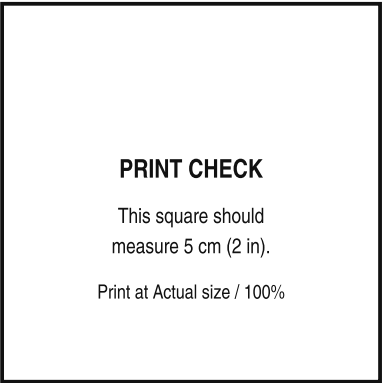
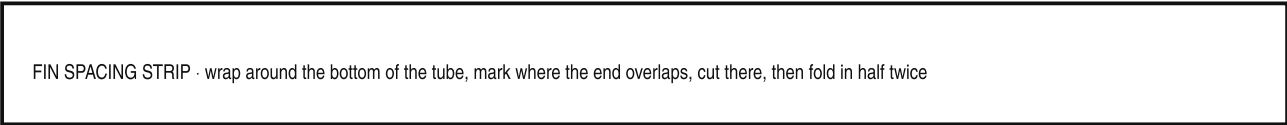
DON'T SWAP THESE

- **No toilet paper or napkins inside the rocket.** They can catch fire. We bring fireproof wadding.
- Keep it paper, cardboard, plastic and glue. No metal parts, and never add anything that burns.

ROCKET TEMPLATE A · FINS



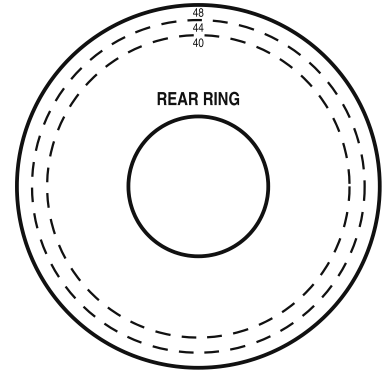
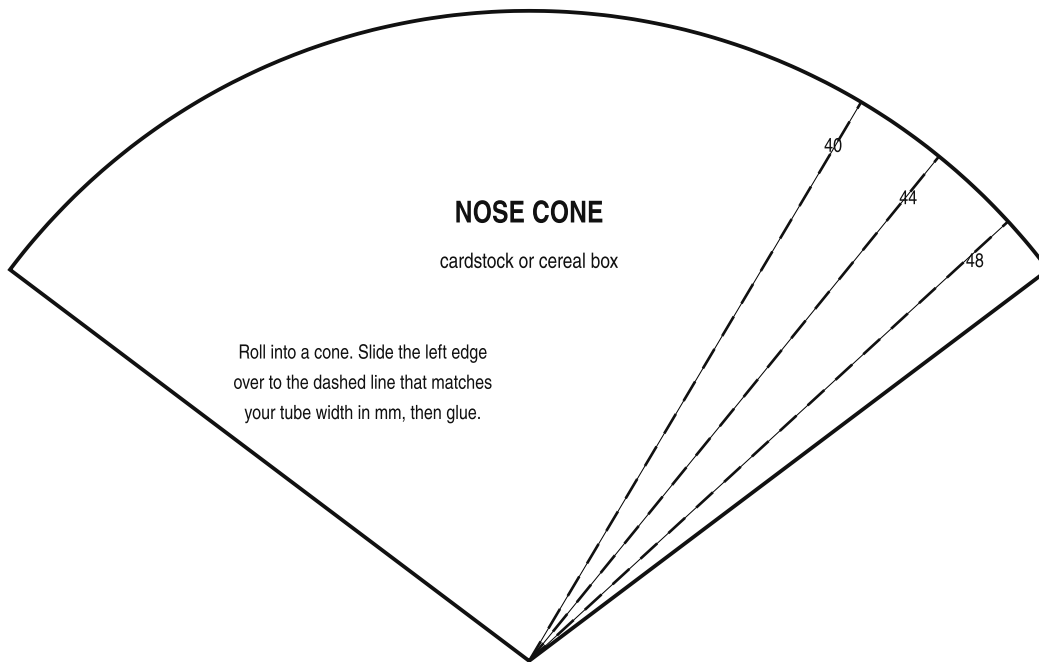
Trace each fin onto cereal box cardboard TWICE (8 pieces). Glue pairs together, printed sides in.



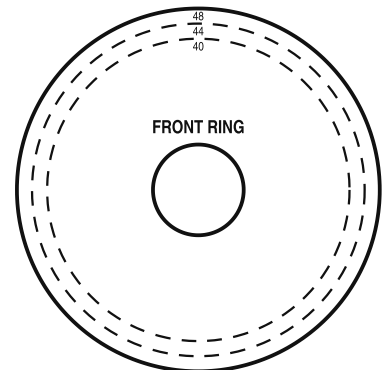
How to fold the strip:

- 1. Wrap it snugly around the tube, bottom edge even with the tube end.
 - 2. Pencil a line where it overlaps. Unwrap and cut on the line.
 - 3. Fold the strip in half, then in half again. Unfold.
 - 4. Wrap it back on. Mark the tube at the end and at each of the 3 creases.
- Those 4 marks are your fin lines.

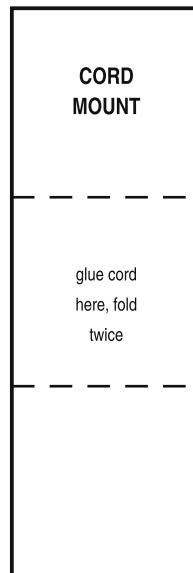
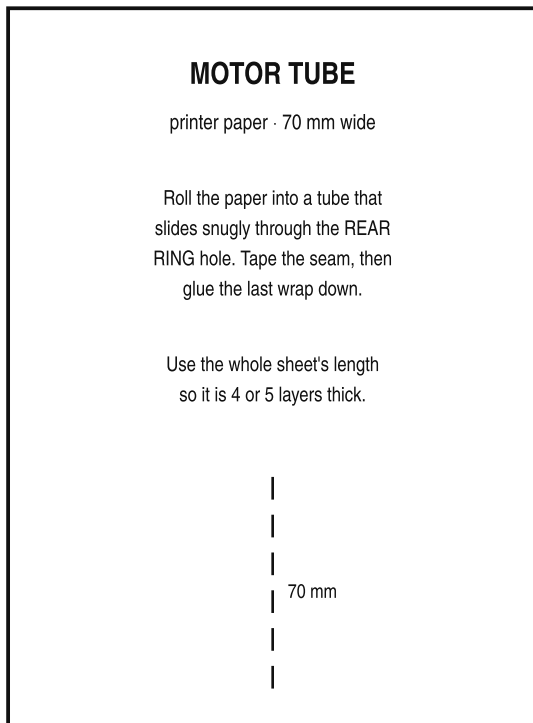
ROCKET TEMPLATE B · NOSE CONE, RINGS, MOUNT



Cut the circle that fits snug inside your tube (mm). Trim to fit if needed.

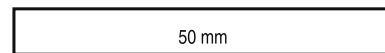


Cut out the center hole too.

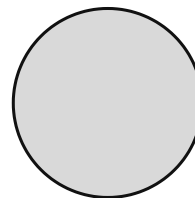


cardstock

LAUNCH STRAW: cut a straw this long

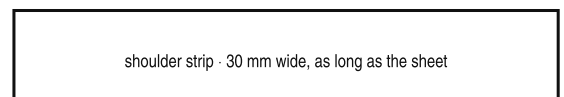


NOSE CLAY: start with a ball this size

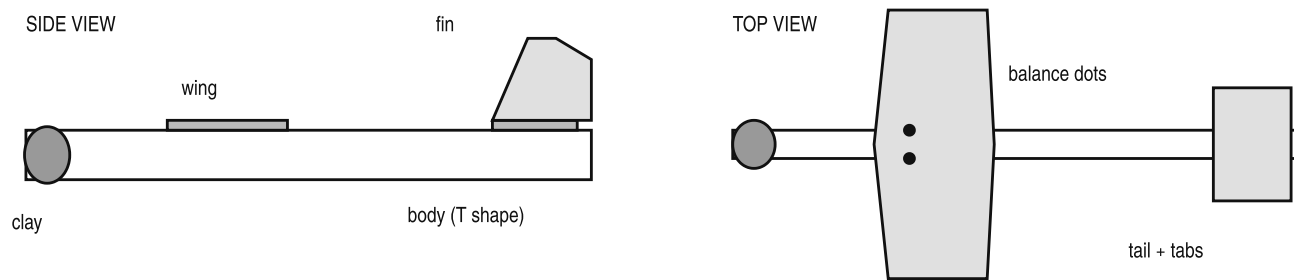


about 15 g
(1 tablespoon)

NOSE SHOULDER: a strip of paper



The manila folder glider



- 1 **Trace the parts.** Cut out the glider template. Glue stick it onto a manila folder, or trace around it. Cut out the wing, body, tail and fin. Cut only the solid lines on the tabs.
- 2 **Fold the body.** Fold the body in half along the middle dashed line and glue the two middle panels together. Fold the two outside flaps outward so they make a flat top. From the front, the body looks like the letter T.
- 3 **Add the wing.** Fold the wing up slightly along its center line so the tips rise about 1.5 cm. Glue the center of the wing onto the flat top of the body, front edge at the "wing front" marks.
- 4 **Add the tail and fin.** Glue the tail flat onto the top of the body at the "tail" marks, front edge forward. Fold the fin's glue tab and glue the fin standing straight up in the middle of the tail.
- 5 **Balance it with clay.** Put your fingertips under the two balance dots on the wing. Squeeze a little clay onto the nose, on both sides of the body, until the glider balances level. Start with a ball about the size of a marble.
- 6 **Test glide.** Hold it under the wing, level with your shoulder, and push it gently straight ahead. Don't throw it hard. Watch how it flies, then use the flight lab below to fix it.

FLIGHT LAB · CHANGE ONE THING AT A TIME

IF IT...	TRY THIS	WHAT HAPPENED?
Swoops up, stops, then drops (a stall)	Add a little clay to the nose, or bend both tail tabs down a tiny bit	
Dives straight into the floor	Take off some clay, or bend both tail tabs up a tiny bit	
Turns or rolls to one side	Check the wing tips are even. Bend the fin tab the opposite way from the turn	
Glides long and smooth	Measure the distance. Now make it turn in a circle on purpose with the fin tab	

CLAY EXPERIMENT

Fly it 3 times each with no clay, a pea of clay, a marble of clay, and two marbles. Measure how far it goes each time. Which amount flies farthest? Why do you think too much and too little both fail?

THE SCIENCE

Like the rocket, a glider needs its balance point in front of where the air lifts it. Clay moves the balance point forward. Tail tabs push the tail up or down, which tips the nose the other way.

GLIDER TEMPLATE · trace onto a manila folder

