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THINGS THAT GO BOOM (OR FLY, FLOAT AND ZOOM)!
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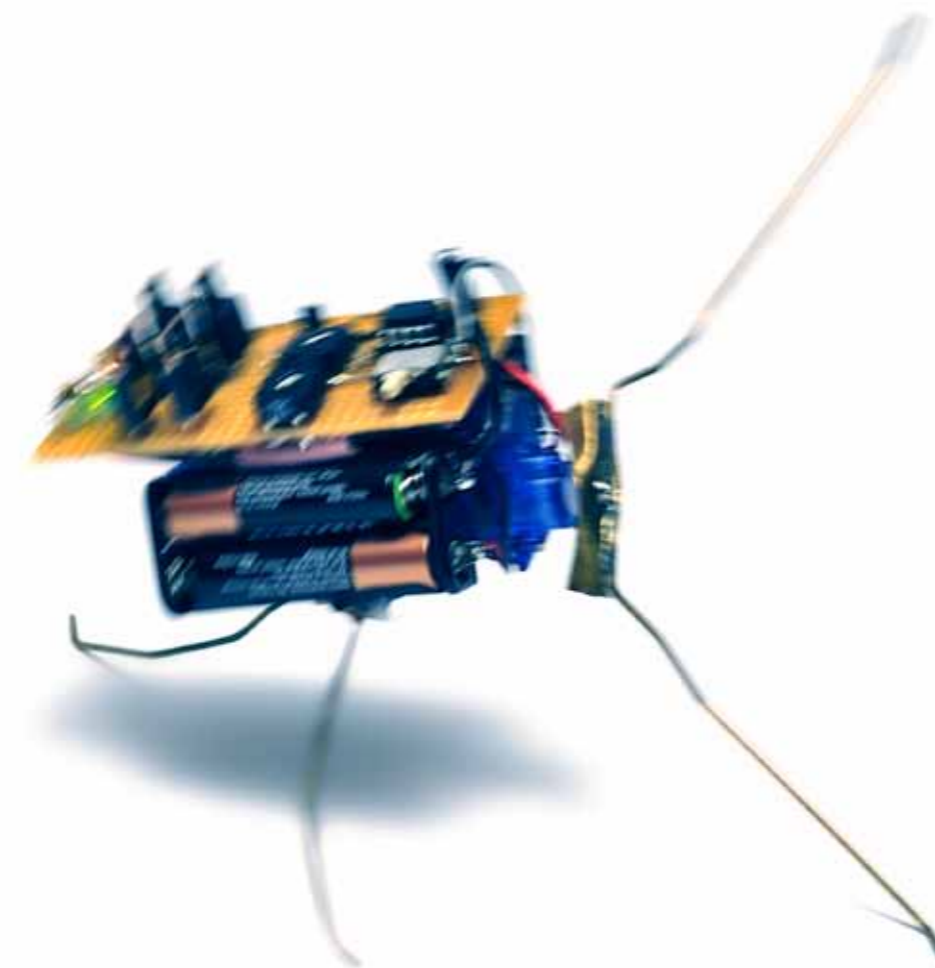
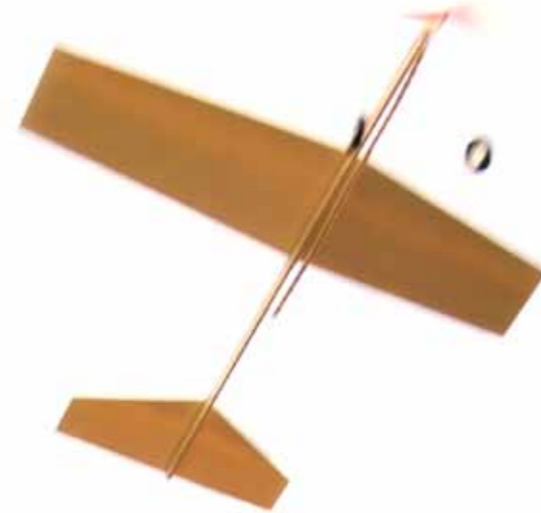
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Pneumatic Boat

Loaded with retro charm, this little boat has old-fashioned tugboat looks and a putt-putt chugging motion through water. It's also very simple to make, so if you have the urge to make something but only a couple of hours to make it in, this project is a good choice. When the balloon is inflated and fitted over the funnel, the air passes through a copper pipe which goes down through the keel and emerges below the boat. Crimping the pipe ensures that the exit point for the air is narrower than the entry point and gives the boat's passage through the water some force and speed. Ensure that you sand the funnel smooth, as any roughness here will puncture the balloon as it is fitted into position—and could bring your boat's maiden voyage to an abrupt end.

YOU WILL NEED

- Prepared knot-free pine, $18 \times 6\frac{1}{2} \times \frac{3}{4}$ inches (450 x 165 x 20mm)—this length allows for cutting waste
- Sheet of cardboard, $11 \times 8\frac{1}{2}$ inches (215 x 280mm)
- 6-inch (150-mm) length of 1-inch- (25-mm) diameter dowel (you can use an old wooden broom handle)—this length allows for cutting waste
- 12-inch (300-mm) length of $\frac{3}{8}$ -inch- (10-mm) diameter soft copper pipe—the type used for easy-to-bend micro plumbing
- Package of big, strong balloons

TOOLS

- Clamps
- Compass (geometrical)
- Cordless drill/driver with a selection of drill bits to fit, including a Forster bit—1 inch (25mm) in diameter
- Craft knife
- Emery paper
- Pencil, rule, and square (for measuring and drawing lines)
- Pliers
- Saber saw with a good selection of “medium” blades to fit
- Sandpaper (fine grade) and sanding block
- Scissors
- Small file
- Straight handsaw
- Waterproof wood glue
- Workbench with vise



PROJECT
10

Soapbox Go-Cart

Although it's scaled strictly for kids, the traditional action and box-on-wheels appearance of this go-cart is bound to create a few nostalgic sighs among adults. It calls for basic woodworking skills, but if you can cut a length of wood, you'll be able to make the whole cart without much trouble. Steering is operated by a simple bar-and-rope arrangement and the only hint of modernity in the whole design is four new wheels, which help to give the passenger a smoother ride than the more rough-and-ready, patched-up versions your grandparents might remember. Don't hesitate to recycle if you have any decent scrap wood or second-hand wheels that you can reuse. Old-style apple boxes, if you can find any, make great box seats, too.

YOU WILL NEED

Pine to make up:

- A: piece, $33\frac{1}{2} \times 2\frac{1}{4} \times 1\frac{1}{4}$ inches (850 × 70 × 30mm)—centerpiece
- B: piece, $17\frac{3}{4} \times 2\frac{1}{4} \times 1\frac{1}{4}$ inches (450 × 70 × 30mm)—crosspiece
- C: piece, $17\frac{3}{4} \times 2\frac{1}{4} \times 1\frac{1}{4}$ inches (450 × 70 × 30mm)—crosspiece
- 2½-inch (65-mm) bolt, $\frac{5}{16}$ inch (8mm) in diameter, with one nut and two washers (for securing the front crosspiece)
- 2-inch (50-mm) bolt, $\frac{5}{16}$ inch (8mm) in diameter, with one nut and two washers (for securing the back crosspiece)
- Wooden crate, about $13\frac{3}{4} \times 13\frac{3}{4}$ inches (350 × 350mm)
- Screws and/or brads to reinforce the crate
- Four 1¼-inch (45-mm) brads
- Three 3-inch (80-mm) carriage bolts, $\frac{5}{16}$ inch (8mm) in diameter, with matching nuts and washers (for attaching the box)
- Two 40-inch (1,000-mm) lengths of $\frac{3}{8}$ -inch- (10-mm) diameter threaded rod
- Eight $\frac{3}{8}$ -inch (10-mm) washers
- Four 13-inch- (330-mm) diameter baby carriage wheels (or a similar substitute)
- Four $\frac{3}{8}$ -inch (10-mm) nuts
- Four $\frac{3}{8}$ -inch (10-mm) cap nuts
- Four 1 × 1 inch (25 × 25mm) corner braces
- Eight 1-inch (25-mm) screws (to attach corner braces)
- 4½-foot- (1,400-mm) length of cord or rope (for steering)

TOOLS

- Adjustable wrenches
- Cordless drill/driver with a good selection of drill bits to fit
- File
- Hacksaw
- Pencil
- Pliers
- Saber saw (or handsaw)
- Sandpaper and sanding block
- Scissors
- Small hammer
- Socket set
- Tape measure
- Try square
- White glue



PROJECT
3

Lemon Cannon

As the saying goes, if life gives you lemons... put them into a homemade cannon and see just how far they can go. Our record for slinging a blameless piece of citrus stands at around a hundred yards, but you may be able to improve on this. The cannon fires under pressure; air is pumped into the pipe by a bicycle foot pump, then released by means of a Schrader valve. The key to a successful flight is to ensure that all the joints are rock solid, so they won't give as the pressure builds. Start, too, with a modest amount of air—if you begin with too much, it's more likely your cannon will spit than your lemon will go stratospheric. This is a good project to try out with kids: You don't need too much time or patience and it's exciting but relatively safe in action.

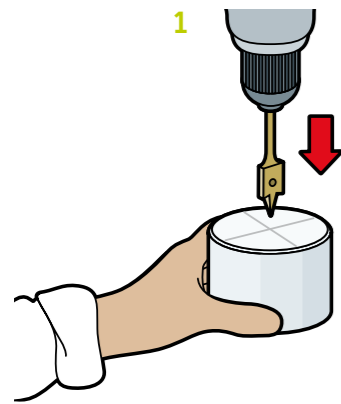
YOU WILL NEED

- 2-inch (50-mm) end cap
- Schrader air valve
- 2-inch (50-mm) straight connector tube
- 6-foot (2,000-mm) length of 2-inch (50-mm) diameter PVC plastic pipe
- Two 2-inch (50-mm) threaded connectors
- Two 2-inch (50-mm) male-to- $\frac{3}{4}$ -inch (20-mm) female threaded reducers
- 20-inch (500-mm) length of $\frac{3}{4}$ -inch (20-mm) diameter copper pipe
- $\frac{3}{4}$ -inch (20-mm) ball valve
- Bicycle foot pump

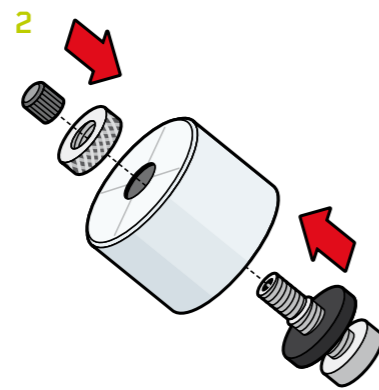
TOOLS

- Adjustable wrench
- Awl
- Cordless drill/driver with a good selection of drill bits to fit
- Hacksaw
- Knife
- Pencil
- Pipe cutter
- PVC primer and adhesive
- Sandpaper (medium grade)
- Silicone sealant
- Steel rule
- Wrenches

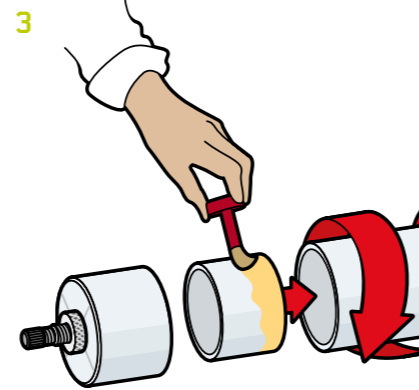
How to Make the Lemon Cannon



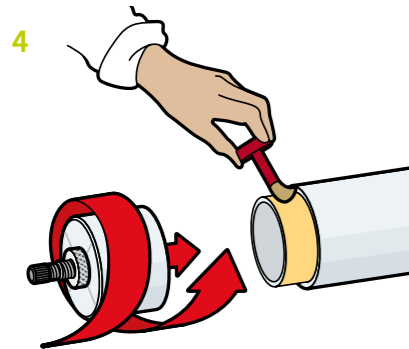
1 Begin by adapting the end cap to take the Schrader air valve. Use a steel rule to mark a cross at the center of the base of the cap. Drill a 1/2-inch (12-mm) hole using a spade bit held in a mounted drill. The drill may melt the plastic as it cuts, so clean away any melted plastic before fitting the valve.



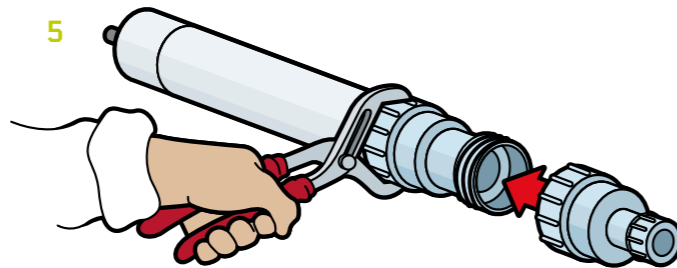
2 Use a nut to secure the Schrader air valve to the end cap, making sure that the rubber washer sits firmly inside the cap for an airtight seal. Use a little silicone sealant to be absolutely certain of a hermetic seal.



3 Now you can begin to join the sections of the cannon. First, add the 2-inch (50-mm) straight connector to the 6-foot (2,000-mm) length of PVC plastic tube (the body tube). Clean the contact surfaces of any grease and then evenly coat them with PVC primer. Once the primer is dry, apply the PVC adhesive to both surfaces, then immediately twist the joint to ensure the glued surfaces make contact and let dry.

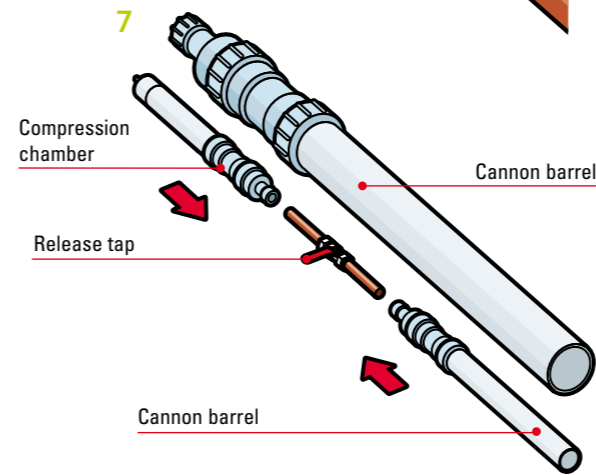
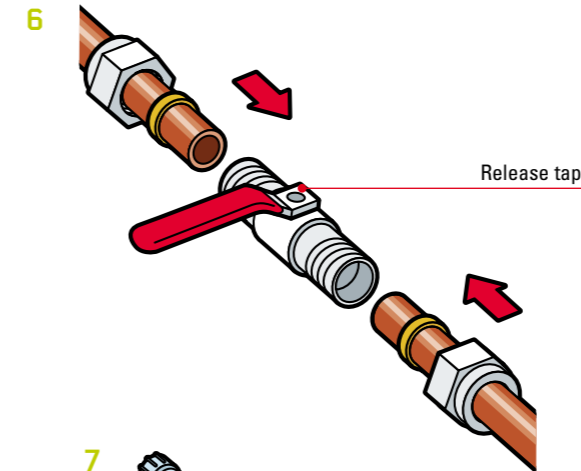


4 Next, attach the straight connector onto the end cap using PVC primer and adhesive, making sure the internal connector is evenly spaced. After 10 minutes, saw the plastic body tube to length. Measure a 2-foot (600-mm) length from the glued joint. Turn the tube against a pencil to mark the cut line, and then cut using a hacksaw. Clean away any rough material with a knife.



5 Now fit the threaded connector to the newly cut end of the body tube to complete the compression chamber. Again, use some silicone sealant to ensure that all mechanical joints are airtight. Next, fit a reducer to the threaded connector, ready to fit the middle section of the lemon cannon—the release tap.

6 The release tap comprises an in-line compression ball valve, with an attached handle. Use the pipe cutter to cut the 20-inch (500-mm) length of copper pipe into two 10-inch (250-mm) lengths. Secure each length of copper pipe on either side of the release tap by using two wrenches turned in opposite directions. The brass balls will compress to make an airtight seal, but add a little silicone sealant to make sure.



7 The barrel of the cannon is a mirror image of the compression chamber, except that it isn't capped at the end. Instead it uses up the remaining 4-foot (1,200-mm) length of PVC plastic tube. Now that you have the compression chamber, the release mechanism, and the barrel complete, simply join them all together by using the two plastic compression joints at the end of the chamber and the barrel.



How to Use It

Close the compression valve, and connect the bicycle foot pump to the Schrader air valve and pump it cautiously until it becomes difficult to push. Don't exceed the pipe rating; most pipes will take 35 psi (pounds per square inch). As you pump, see if air is coming out of any of the joints (you can loosely cover lengths of piping with plastic wrap; you'll see it move if there are any leaks). If you find any leaks, seal again with PVC adhesive. Hold the cannon at a 45-degree angle to achieve maximum trajectory. Finally, select a lemon, or similar fruit, that fits into the cannon's mouth. Check that the cannon is not pointing at anyone and open the valve with one swift action.



Tip

Use a fruit or vegetable that fits into the barrel well, but not tightly. If it is wedged in or too small, the compressed air will escape without propelling the projectile. Lemons and limes are a good choice because they are round and elongated. If the fruit is too large, try trimming some peel off. If it is too small, try adding duct tape to increase its girth.

Free-Flight Airplane

There's something very satisfying about working in balsa wood: it offers all the joys of carpentry without any of the hard labor involved. The propulsion mechanism comes from a model store, leaving you with the work of cutting the pieces, conducting trial flights and amending elements to enhance its performance. Make several models, and you'll find that each one, however identical it looks to the others, will fly slightly differently. The glider's structure is simple enough for children to help with, or even make entirely themselves. If your family has a competitive streak, you can organize a contest for the best construction, the best physique, and, of course, the glider that flies the longest distance.

YOU WILL NEED

Balsa stick to make up:

- A: piece, $14\frac{1}{2} \times \frac{3}{8} \times \frac{1}{8}$ inches (370 × 10 × 3mm)—fuselage

Balsa wood sheet to make up:

- B: piece, $8\frac{3}{4} \times 3\frac{1}{2} \times \frac{1}{8}$ inches (220 × 90 × 3mm)—left wing
- C: piece, $8\frac{3}{4} \times 3\frac{1}{2} \times \frac{1}{8}$ inches (220 × 90 × 3mm)—right wing
- D: piece, $7.9 \times 3 \times \frac{1}{16}$ inches (200 × 75 × 2mm)—tailplane
- E: piece, $2.5 \times 2.5 \times \frac{1}{16}$ inches (65 × 65 × 2mm)—fin
- Balsa cement
- 9 inches (230mm) of 20-AWG- (0.812mm diameter) piano wire
- $\frac{5}{2}$ -inch (140-mm) plastic propeller with shaft and eye, and nose bearing with undercarriage slots, for fitting onto $\frac{3}{8} \times \frac{1}{8}$ inch (10mm × 3mm) fuselage—this is most common type sold in model stores
- Two 1-inch- (25-mm) diameter foam wheels
- Rubber band, $15\frac{3}{4}$ -inch (400-mm) circumference
- Straight brad
- Plasticine (modeling clay)

TOOLS

- Adhesive tape
- Craft knife
- Long-nose pliers and pliers
- Metal rule
- Pencil
- Razor saw
- Scissors
- Two sheets of thin cardboard or paper, $8\frac{1}{2} \times 11$ inches (215 × 280mm)—for templates

