Experimental Aircraft & Rocket Launcher

The concept and design of the Experimental Aircraft & Rocket Launcher was inspired by one that can be found on NASA's educational website. In addition to instructions for building a similar rocket launcher, many other educational resources are available for free at http://NASA.GOV.

Contents:

- WARNING - WARNING - WARNING - WARNING -

This air rocket launcher is NOT A TOY and should be used ONLY by a responsible adult. Projectiles are launched at a very high rate of speed and are capable of causing serious injury. As with any model rocket system, common sense and caution must be used while launching rockets. Never place a foreign object in the launch tube or pressure chamber.

Before each use:

1 - Verify the assembly is correct and all required joints are appropriately glued and/or tightened per instructions.

2 - Check the interior of the launcher and launch tube to verify there are no obstructions or loose items inside. Remove any items before adding pressurized air.

3 - Add the threaded cap and valve stem to the assembly (E). This component should be added to the launcher at the time of use by a responsible adult ONLY.

After Each Use:

1- Point the launch tube (N) away from people and property, then release pressurized air from the chamber by opening the valve (I).

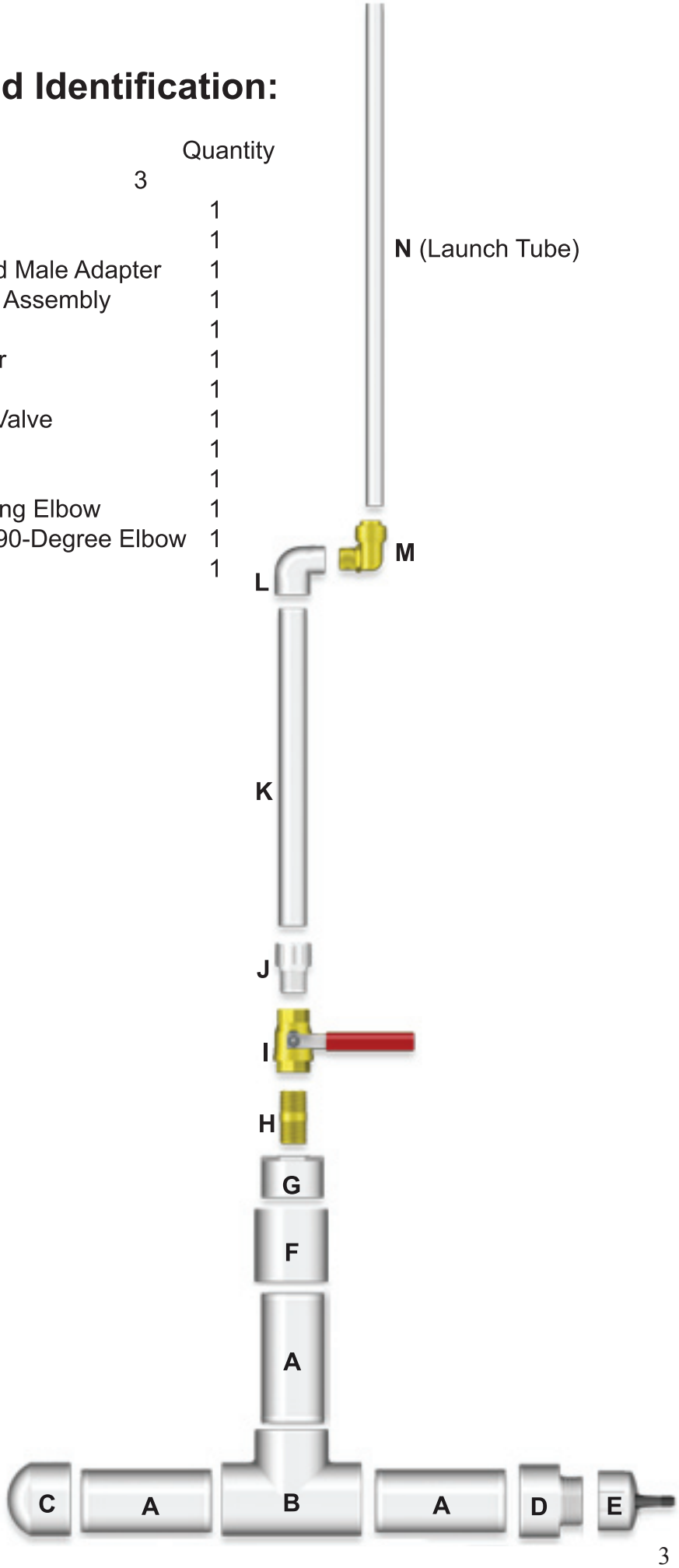
2- Remove the Threaded Cap & Valve Stem Assembly (E) and store in a safe place separate from the rest of the launcher assembly.

Air Launcher Parts List and Identification:

Part ID	Description	Quantity
A	2” x 5” (L) PVC Pipe	3
B	2” PVC Tee	1
C	2” PVC Slip-On Cap	1
D	1-1/2” x 2” PVC Reducing Threaded Male Adapter	1
E	1-1/2” Threaded Cap & Valve Stem Assembly	1
F	2” PVC Coupling	1
G	2” to 3/4” Female Threaded Adapter	1
H	3/4” x 2” Brass Threaded Adapter	1
I	3/4” Brass Full Port Threaded Ball Valve	1
J	3/4” PVC Male Adapter	1
K	3/4” x 12” PVC Pipe	1
L	3/4” to 1/2” PVC 90-Degree Reducing Elbow	1
M	SharkBite™ 1/2 in. X 1/2 in. Brass 90-Degree Elbow	1
N	SharkBite™ 1/2 in. X 19” PEX Pipe	1

Additional Supplies (provided):
1 can of PVC solvent cement
1 roll of teflon tape
1 pump with pressure gauge

Recommended (not included)
Petroleum jelly or grease



Assembly Instructions

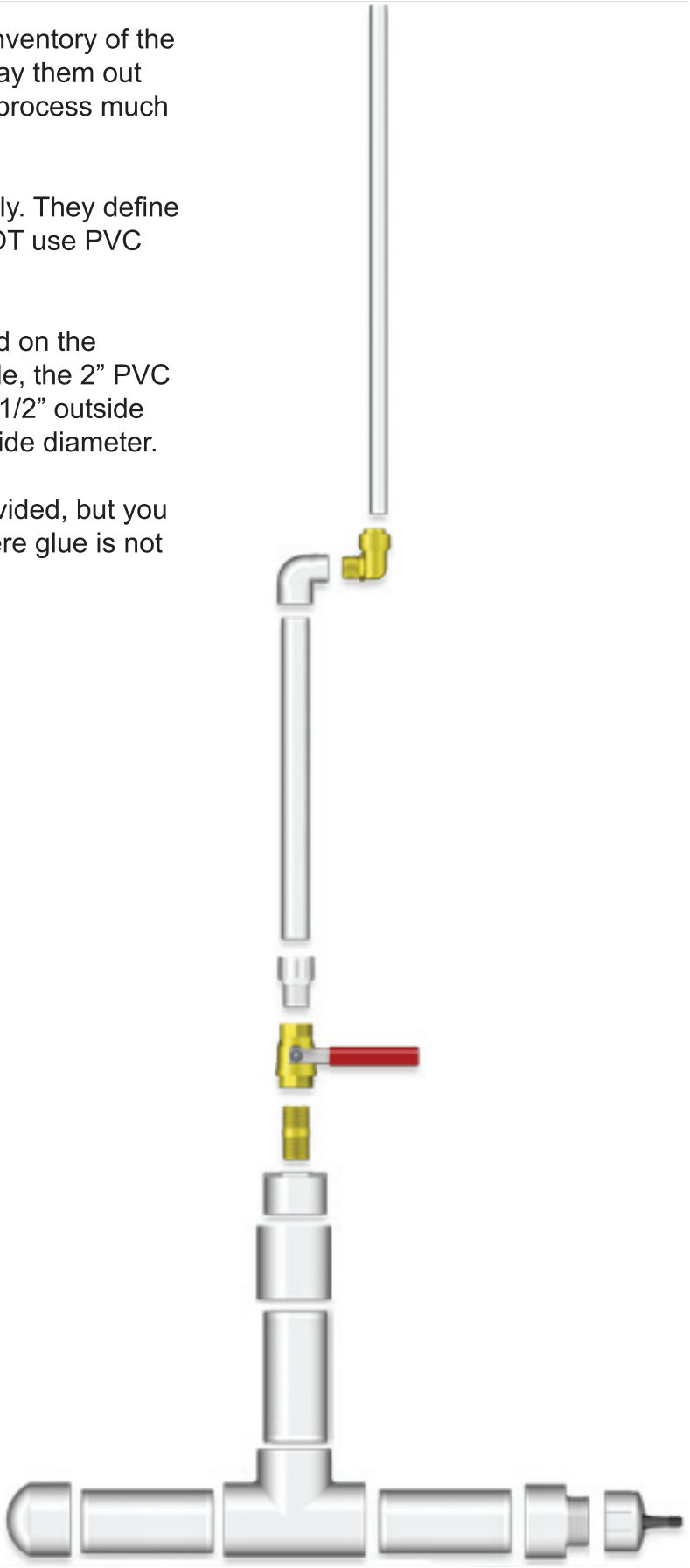
NOTES:

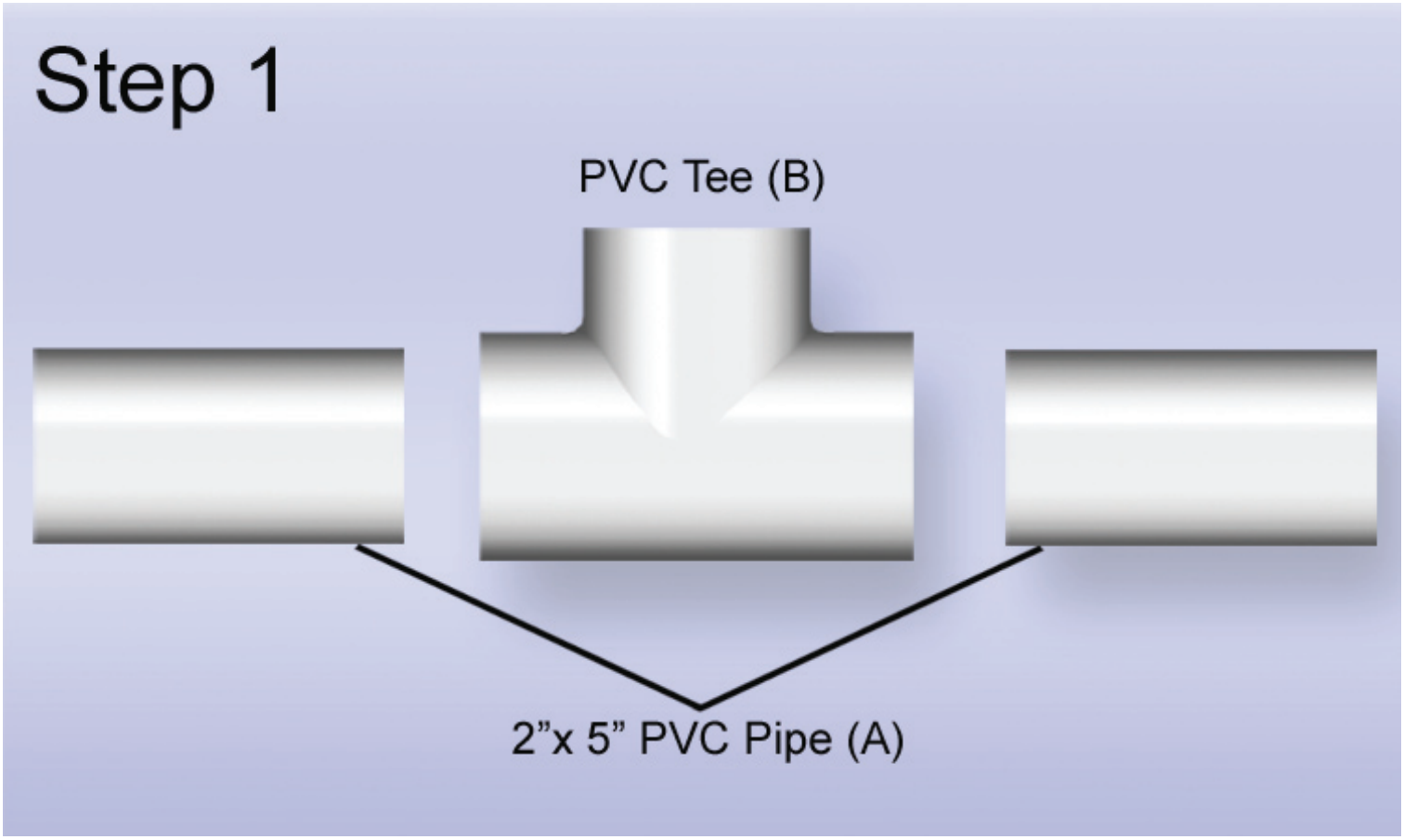
• Before beginning assembly, please complete inventory of the launcher's components. You may even want to lay them out as seen here. Doing so will make the assembly process much easier.

• Please follow the assembly instructions carefully. They define which components you should and SHOULD NOT use PVC cement on.

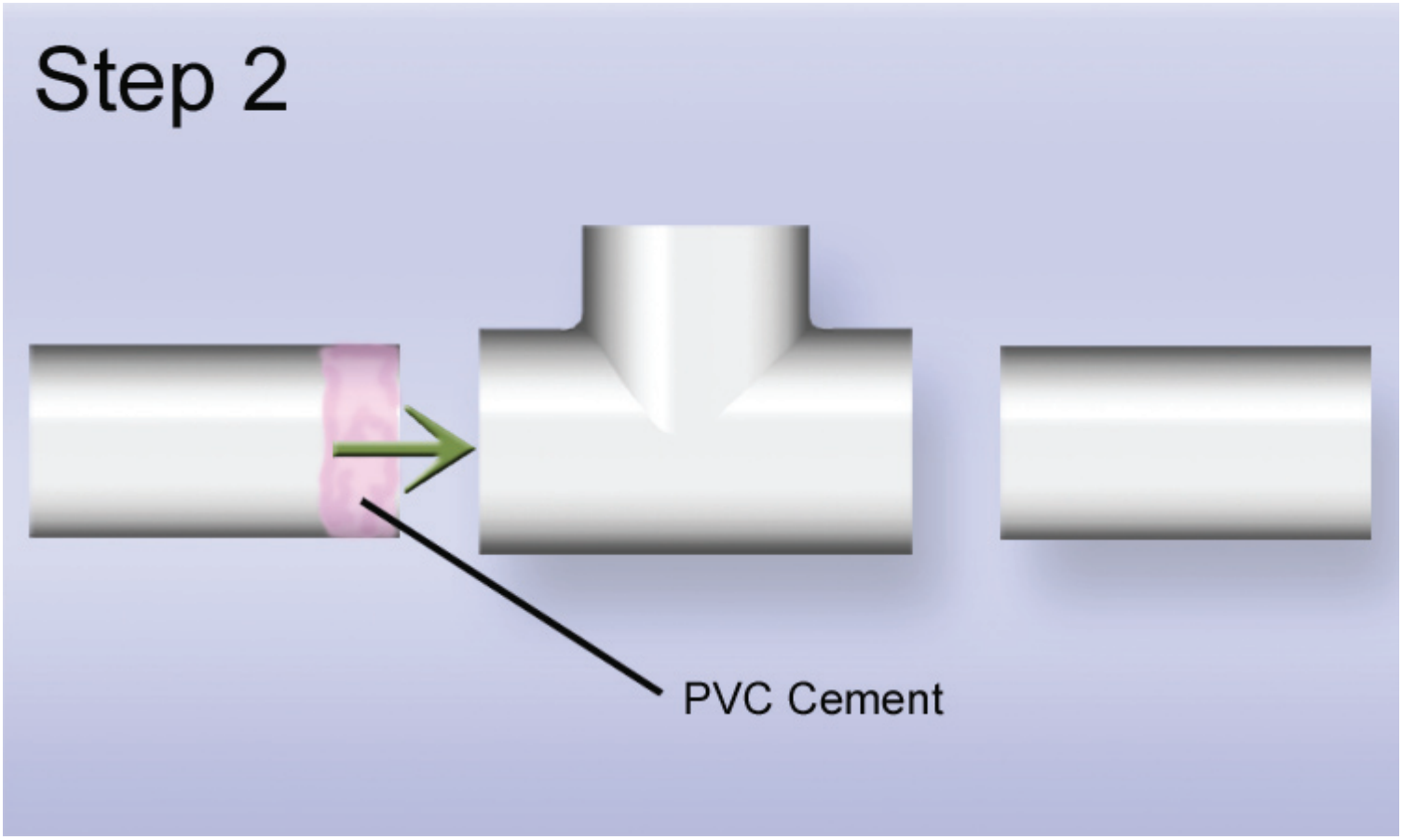
• References to PVC component sizes are based on the inside diameter of the related piping. For example, the 2" PVC Tee seen on the opposite page actually has a 2-1/2" outside diameter, but mates with a pipe that has a 2" inside diameter.

• All required components and materials are provided, but you may want to apply grease or petroleum jelly where glue is not used (which will be defined in the instructions).

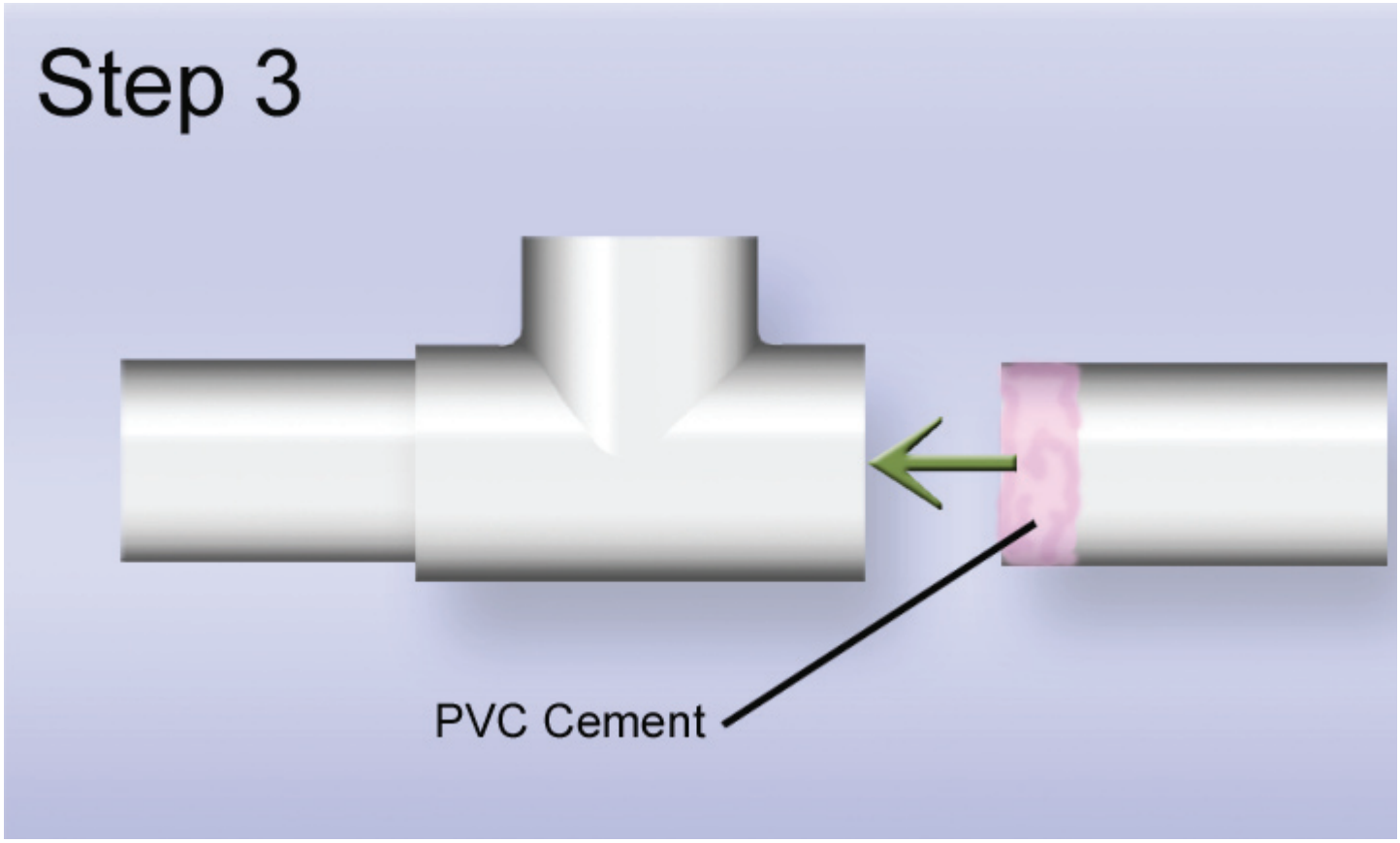




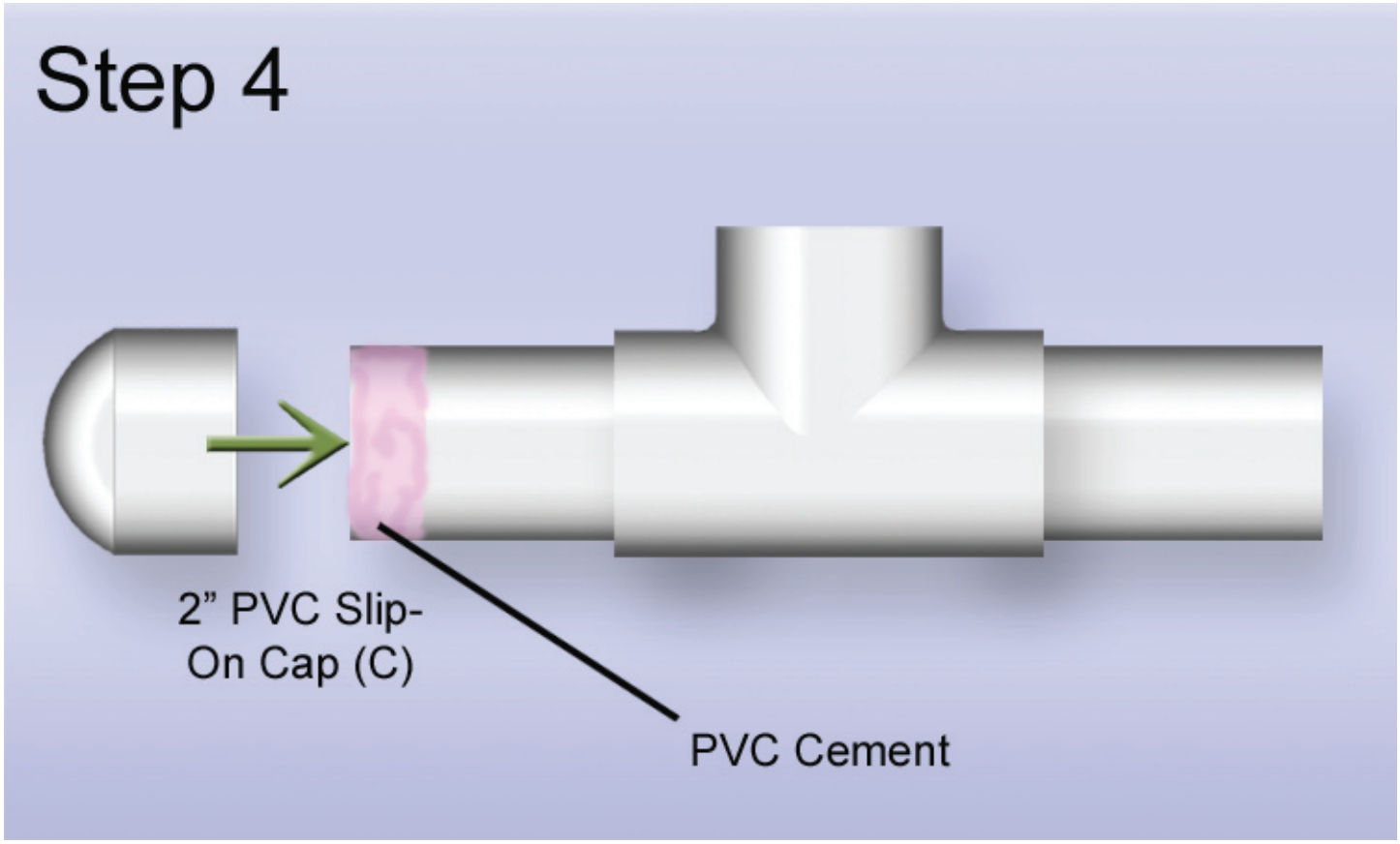
Locate two **2” x 5” long PVC Pipes (A)** and one **2” PVC Tee (B)**. You will be working with solvent PVC cement. It sets almost immediately when piping is assembled. Make sure to follow the instructions carefully.



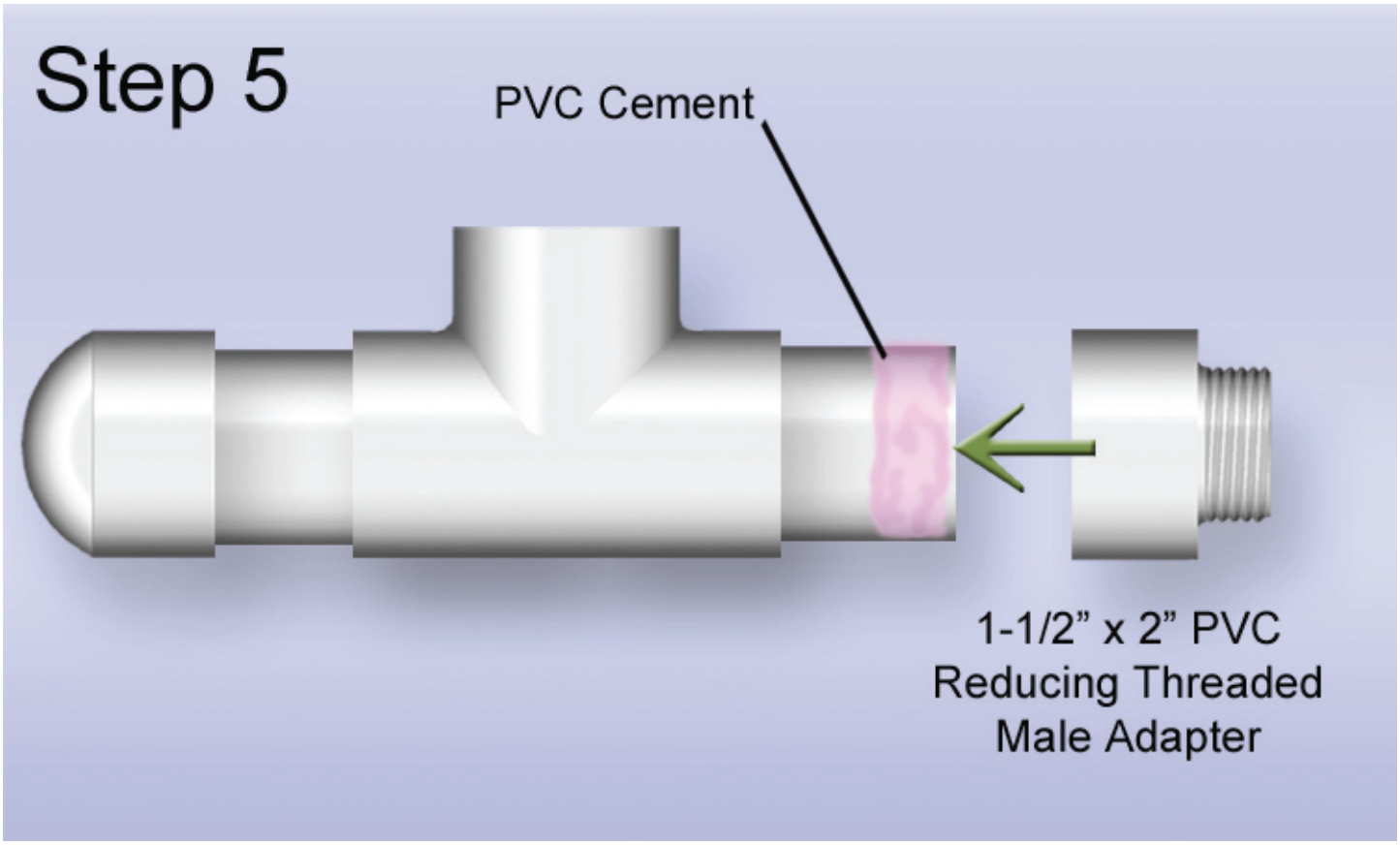
Apply solvent PVC cement liberally around one end of the first PVC pipe and insert into the PVC tee. Make sure the pipe is seated well in the tee. Tapping the pipe in lightly with a rubber mallet can ensure a good seal.



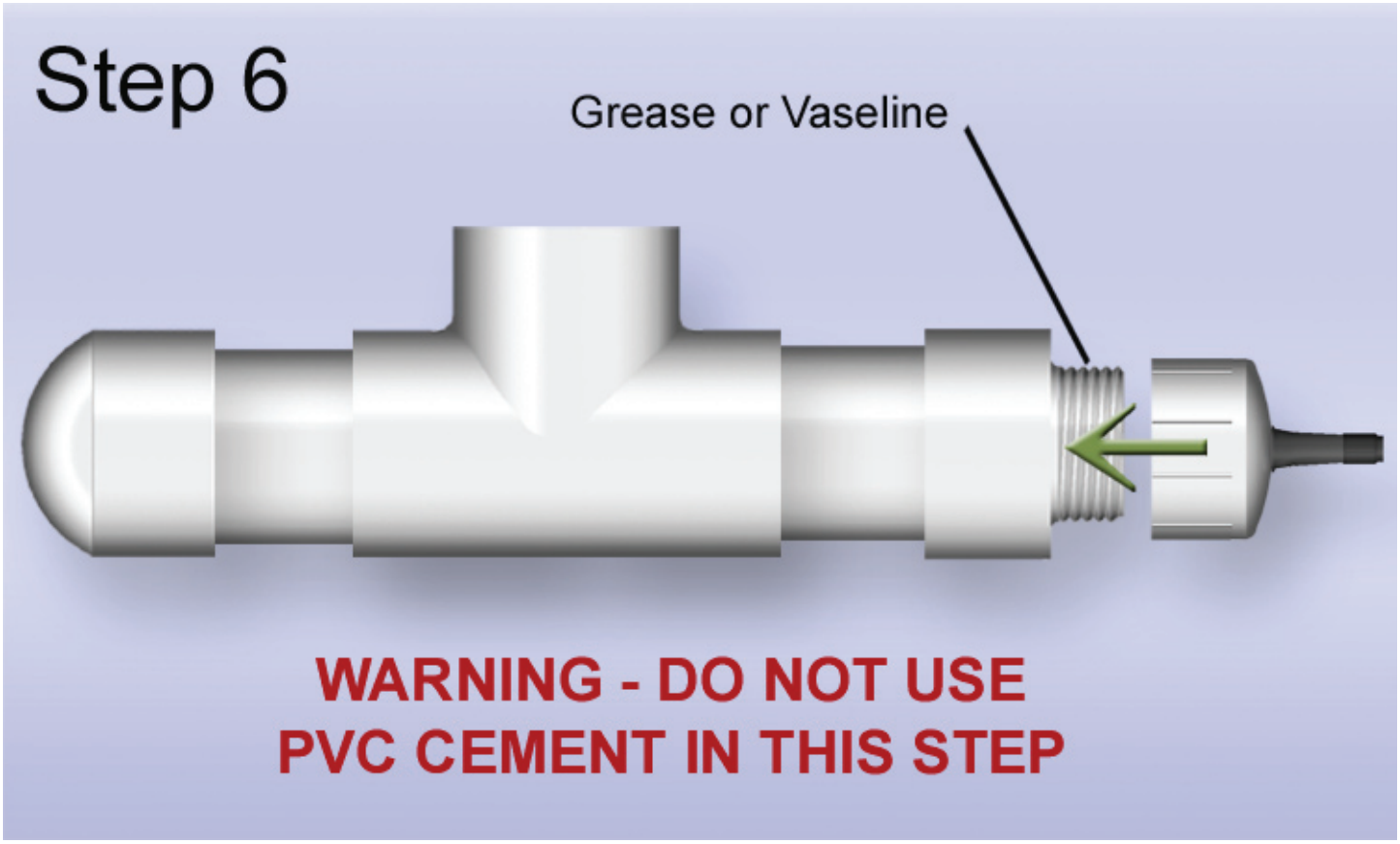
Apply solvent PVC cement liberally around one end of the second PVC pipe and insert into the opposite side of the PVC tee. Once again, make sure the pipe is seated well.



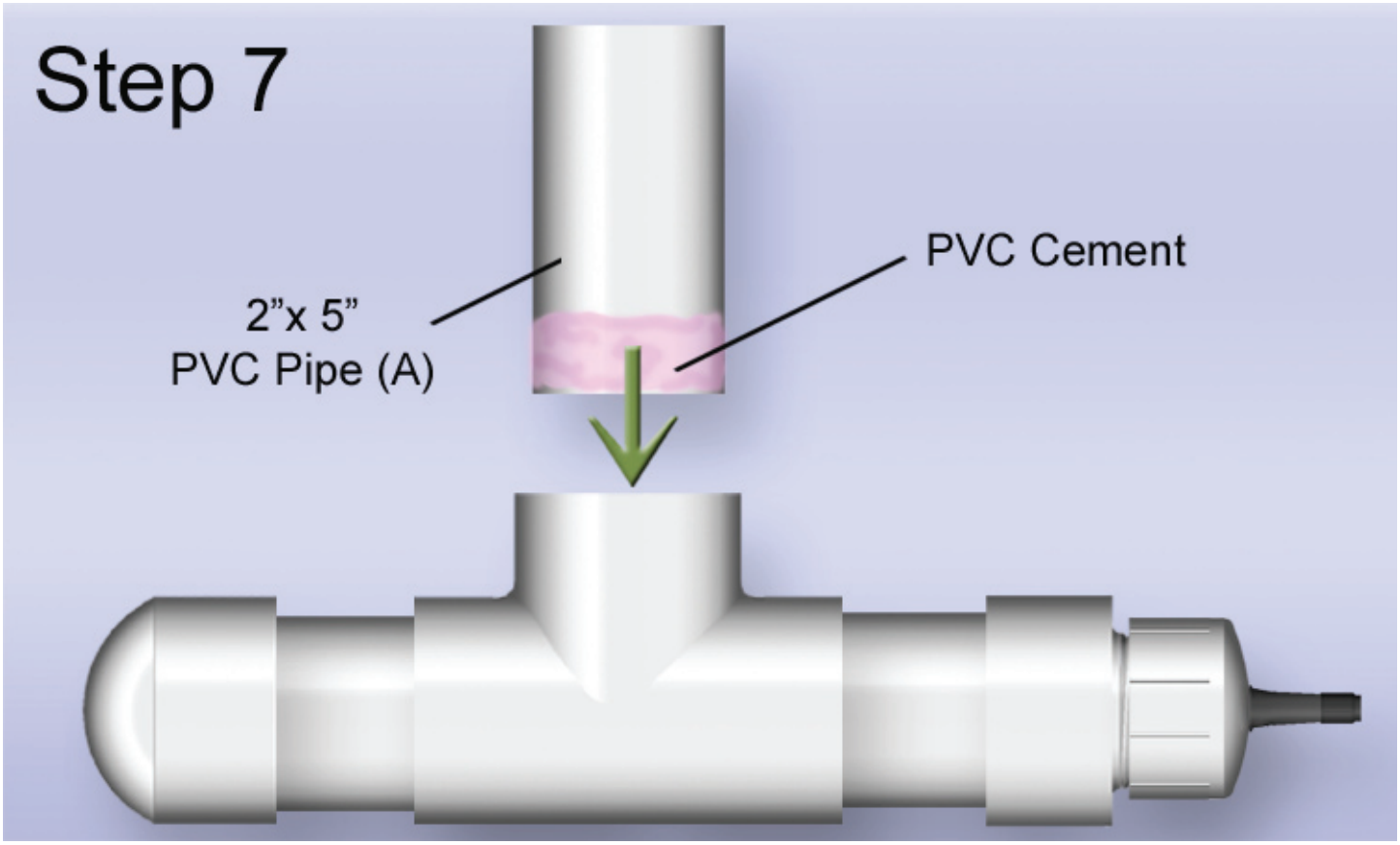
Apply PVC cement around the end of one of the exposed PVC pipes, then place the **PVC Slip-On Cap (C)** on the pipe.



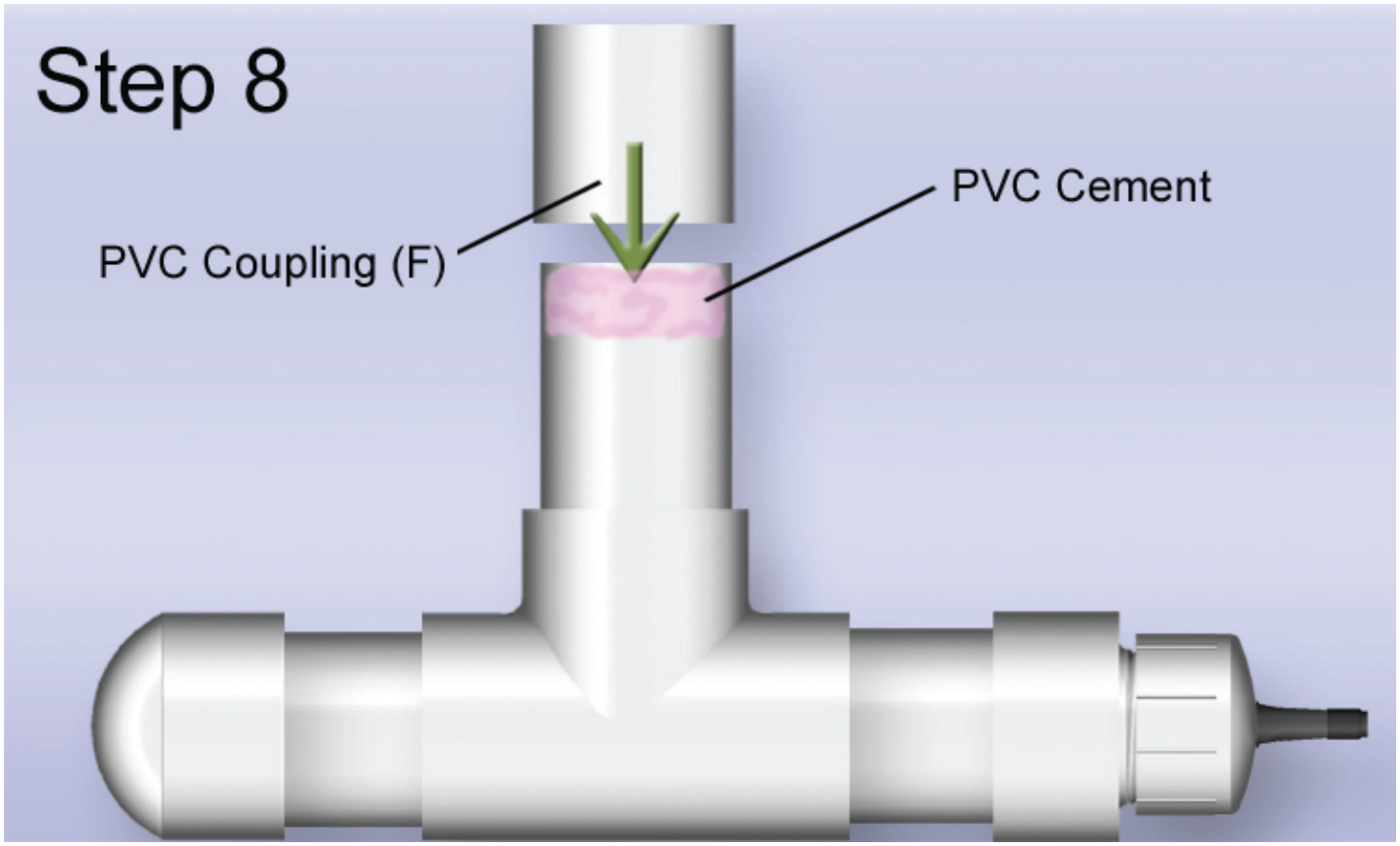
Apply solvent PVC cement around the end of the remaining exposed PVC pipe, then slide the **PVC Reducing Threaded Male Adapter (D)** onto the pipe.



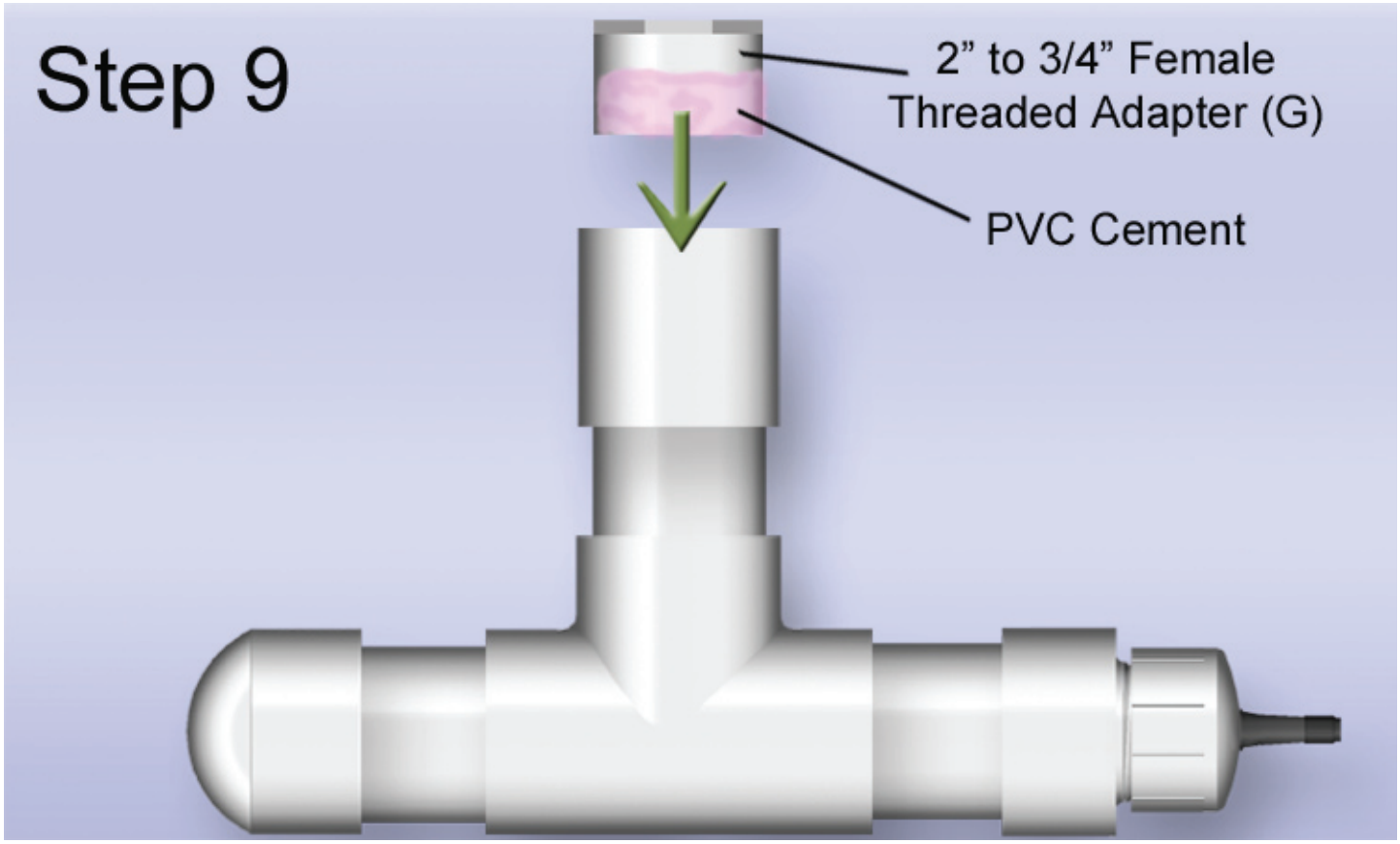
Screw the **Threaded Cap with Valve Stem (E)** onto the end of the assembly. **DO NOT USE CEMENT!** We recommend applying some grease or Vaseline™ to help seal the threads while keeping the cap removable for future servicing.



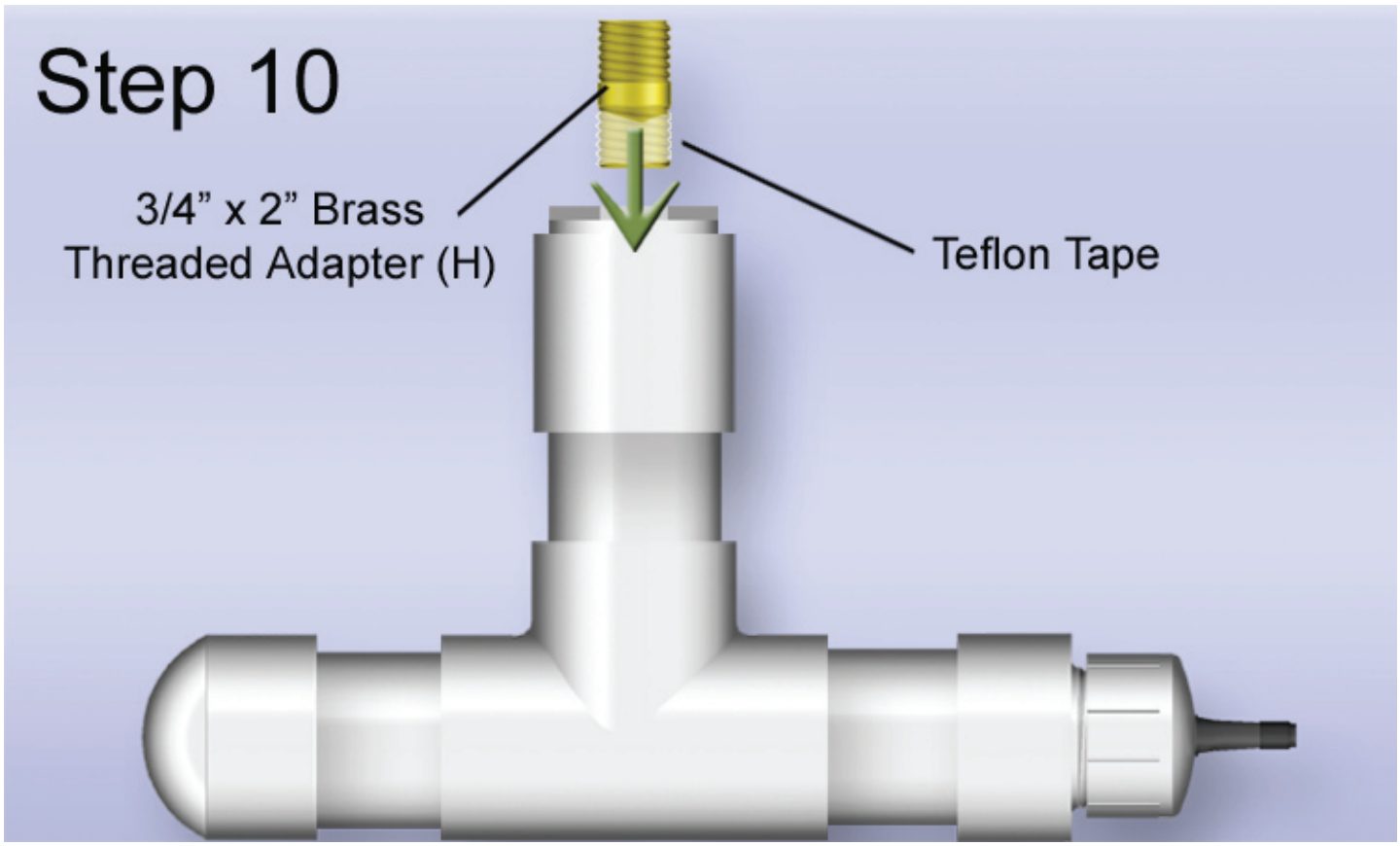
Apply PVC cement around the remaining **2-1/2” long PVC Pipe (A)** and insert it in the top of the PVC tee.



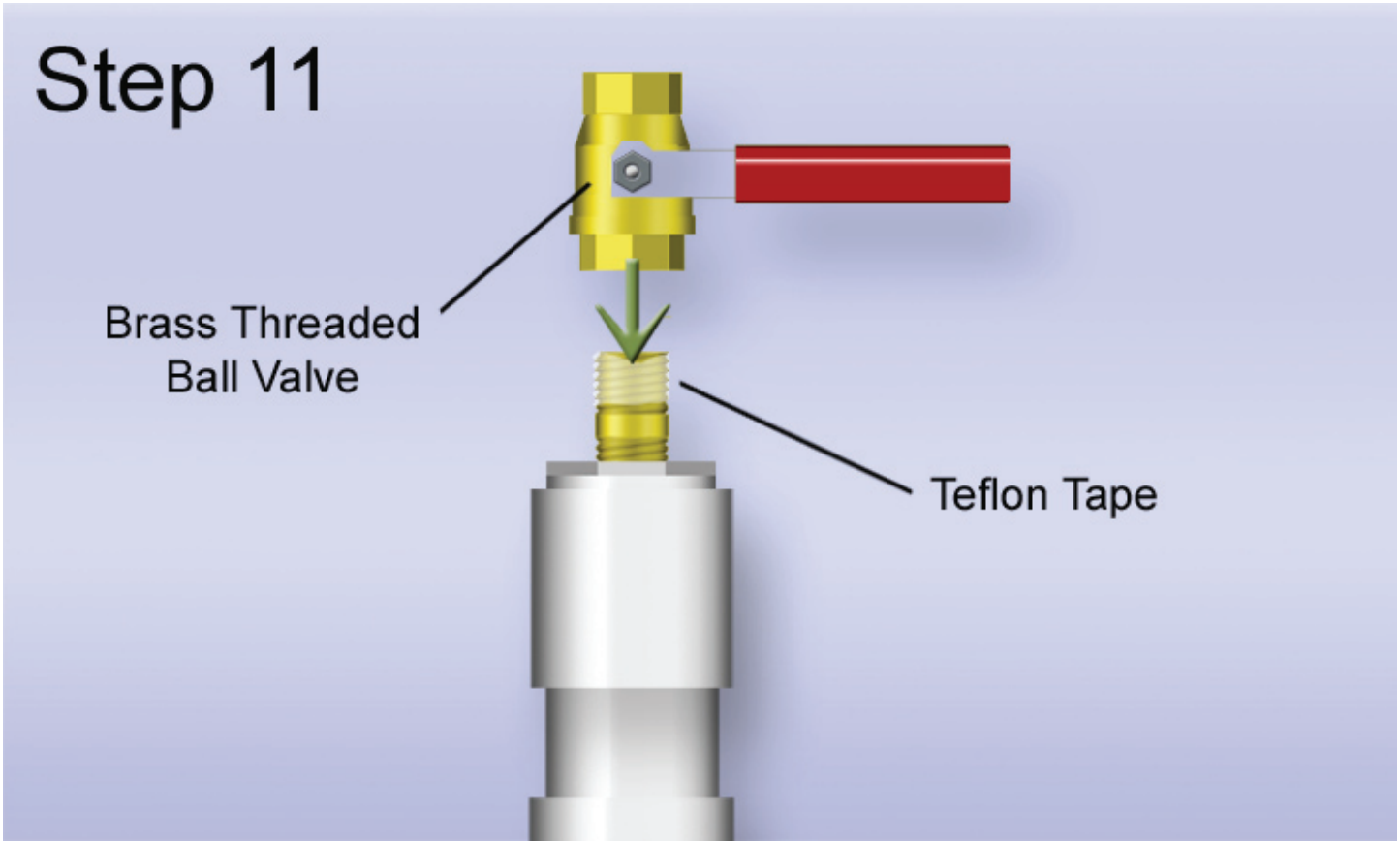
Apply PVC cement around the exposed **PVC Pipe (A)** and slide the **2” PVC Coupling (F)** over the pipe.



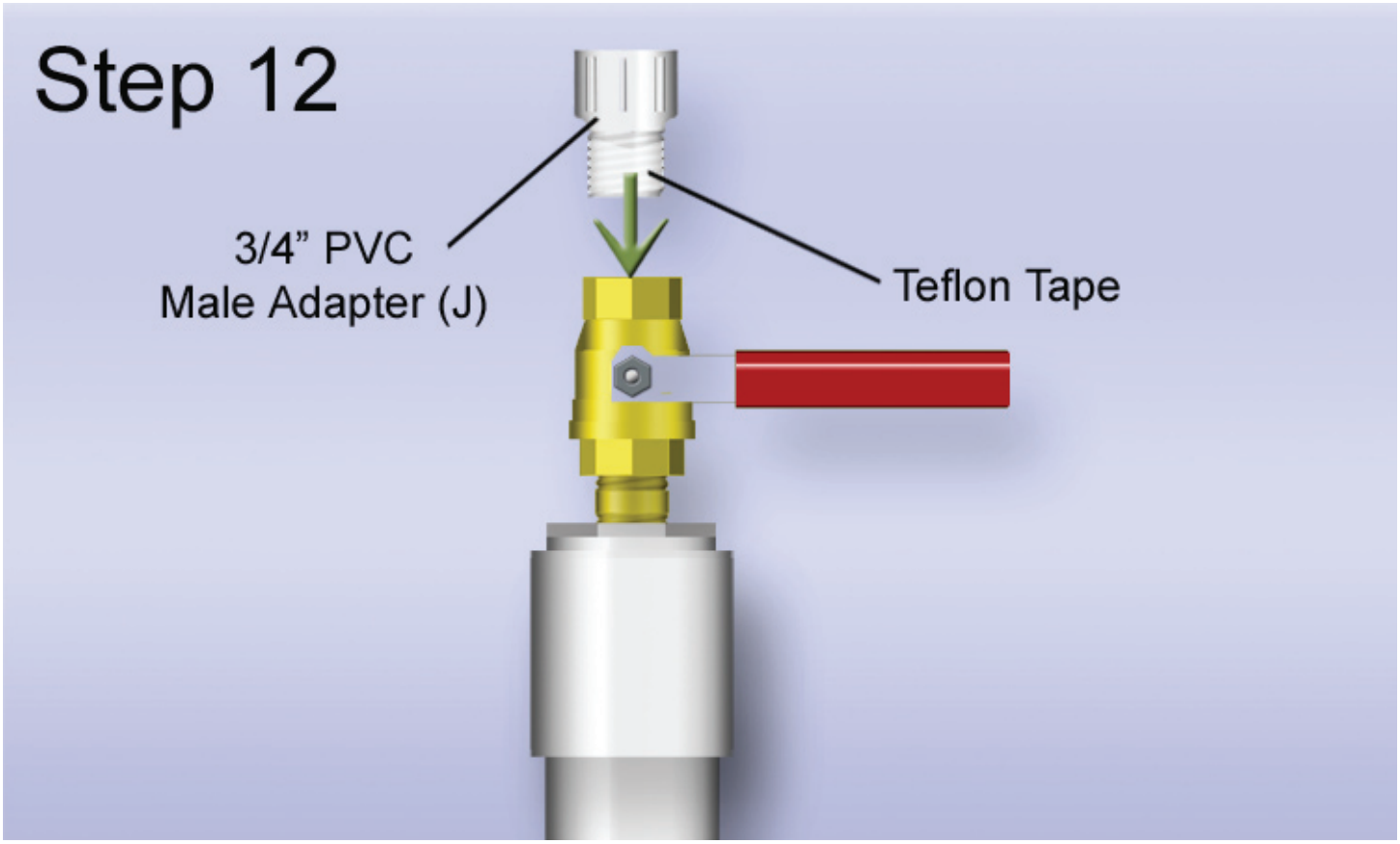
Apply PVC Cement around the **2” to 3/4” Female Threaded Adapter (G)** and slide into the **PVC Coupling (F)**.



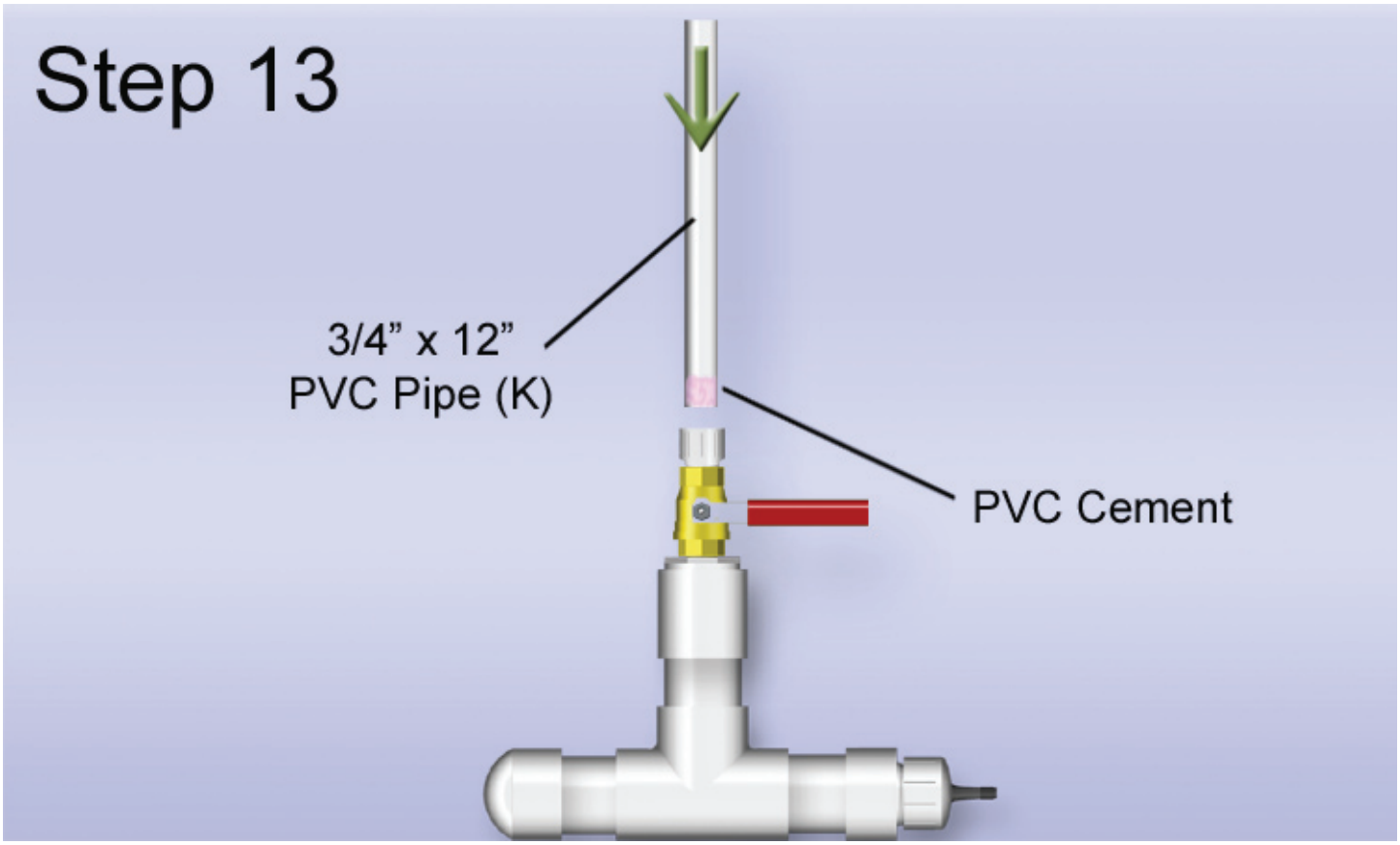
Apply Teflon Tape around the end of the **3/4” x 2” Brass Threaded Adapter (H),** then screw it into the assembly as seen here. Use pliers if necessary, but do not over-tighten.



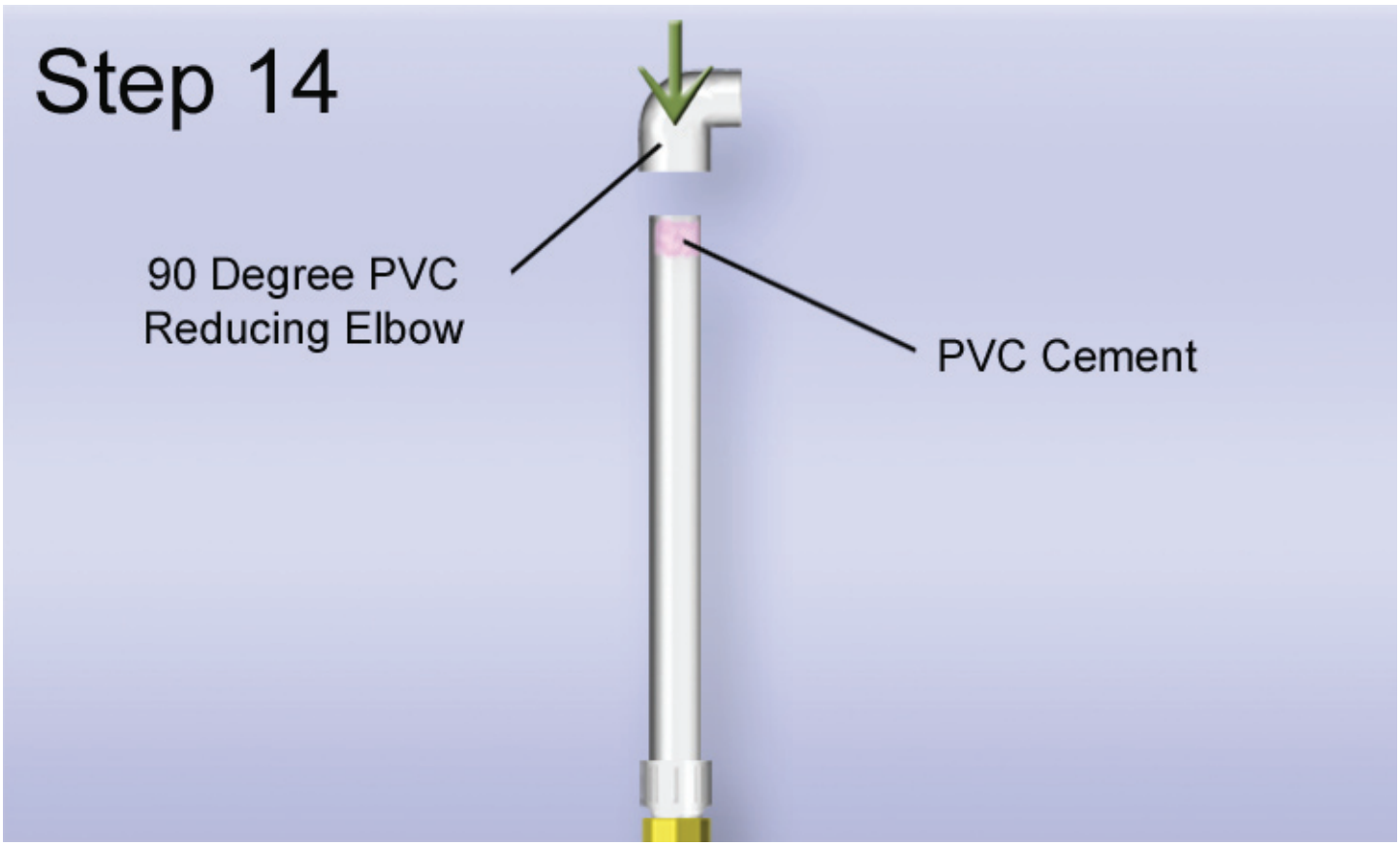
Apply teflon tape around the exposed end of the **3/4" x 2" Brass Threaded Adapter (H),** then screw the **3/4" Brass Full Port Threaded Ball Valve (I)** onto the assembly. The valve will work either way, so you need to decide if you want to push or pull to launch rockets. The handle indicates the directions for on and off.



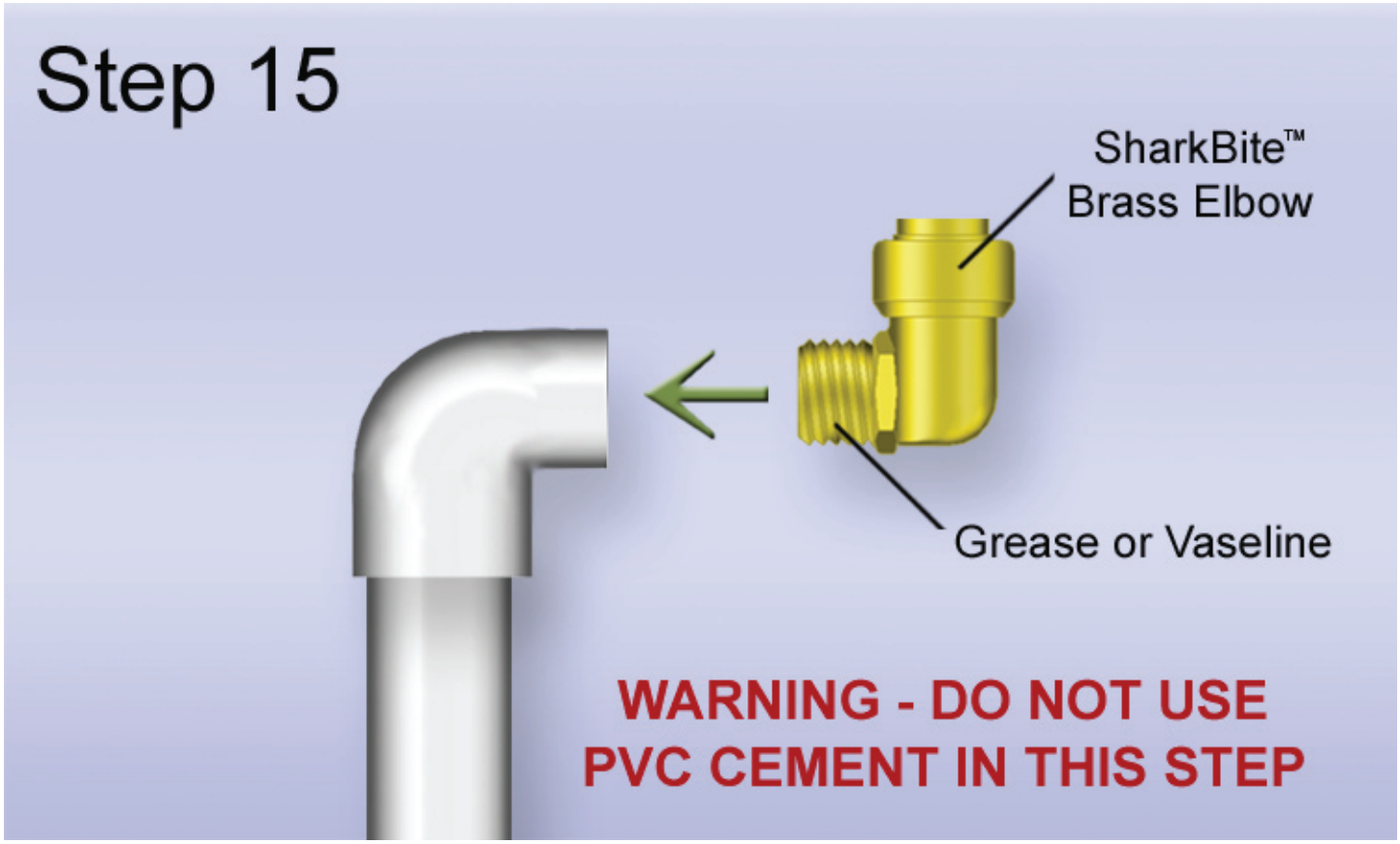
Apply teflon tape around the end of the **3/4" PVC Male Adapter (J)**, then screw it into the remaining end of the ball valve. Make sure the adapter is adequately tightened so that it won't leak air or easily turn in the valve.



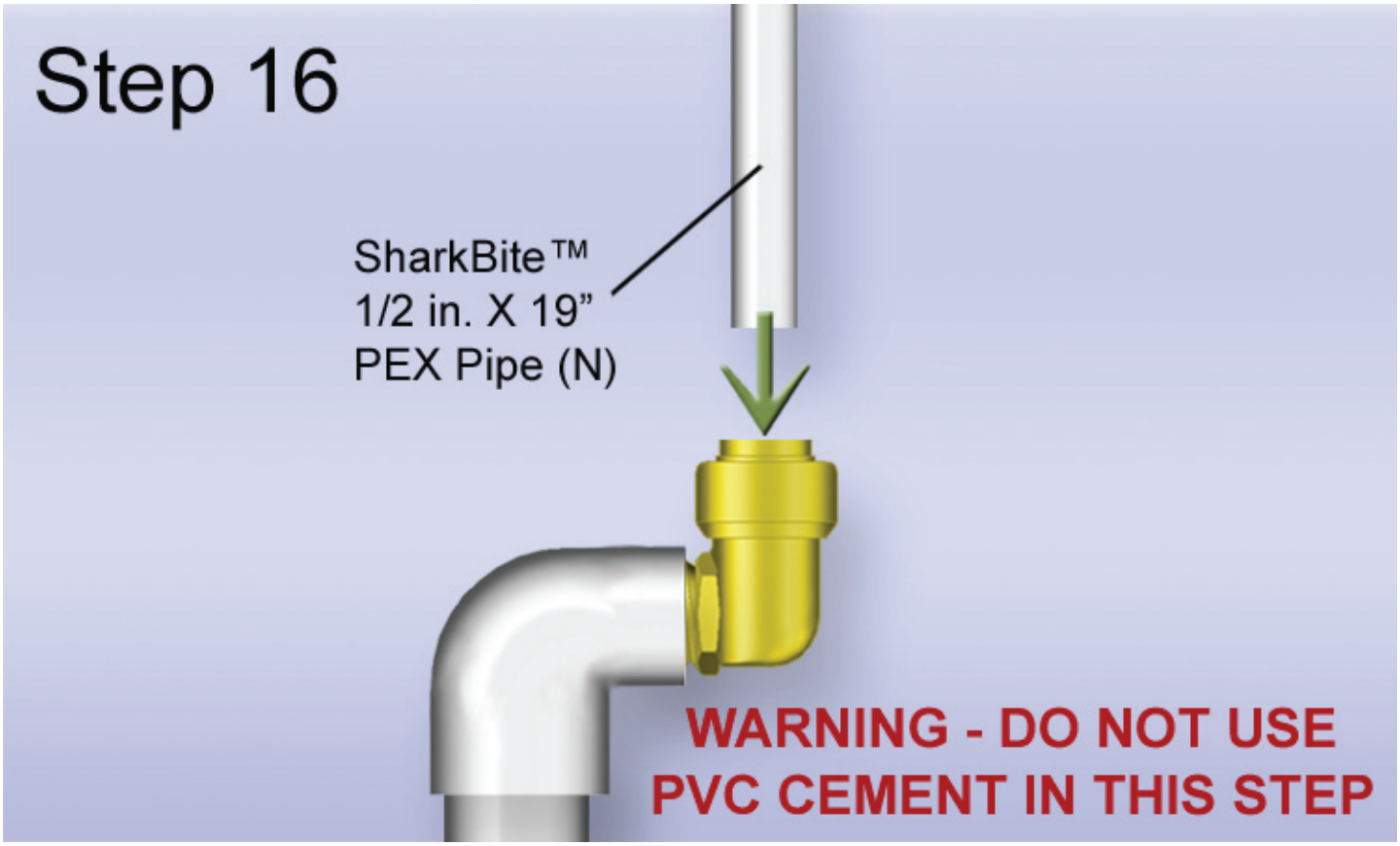
Apply PVC cement to one end of the **3/4” x 12” PVC Pipe (K)**, then insert into the PVC adapter as seen here.



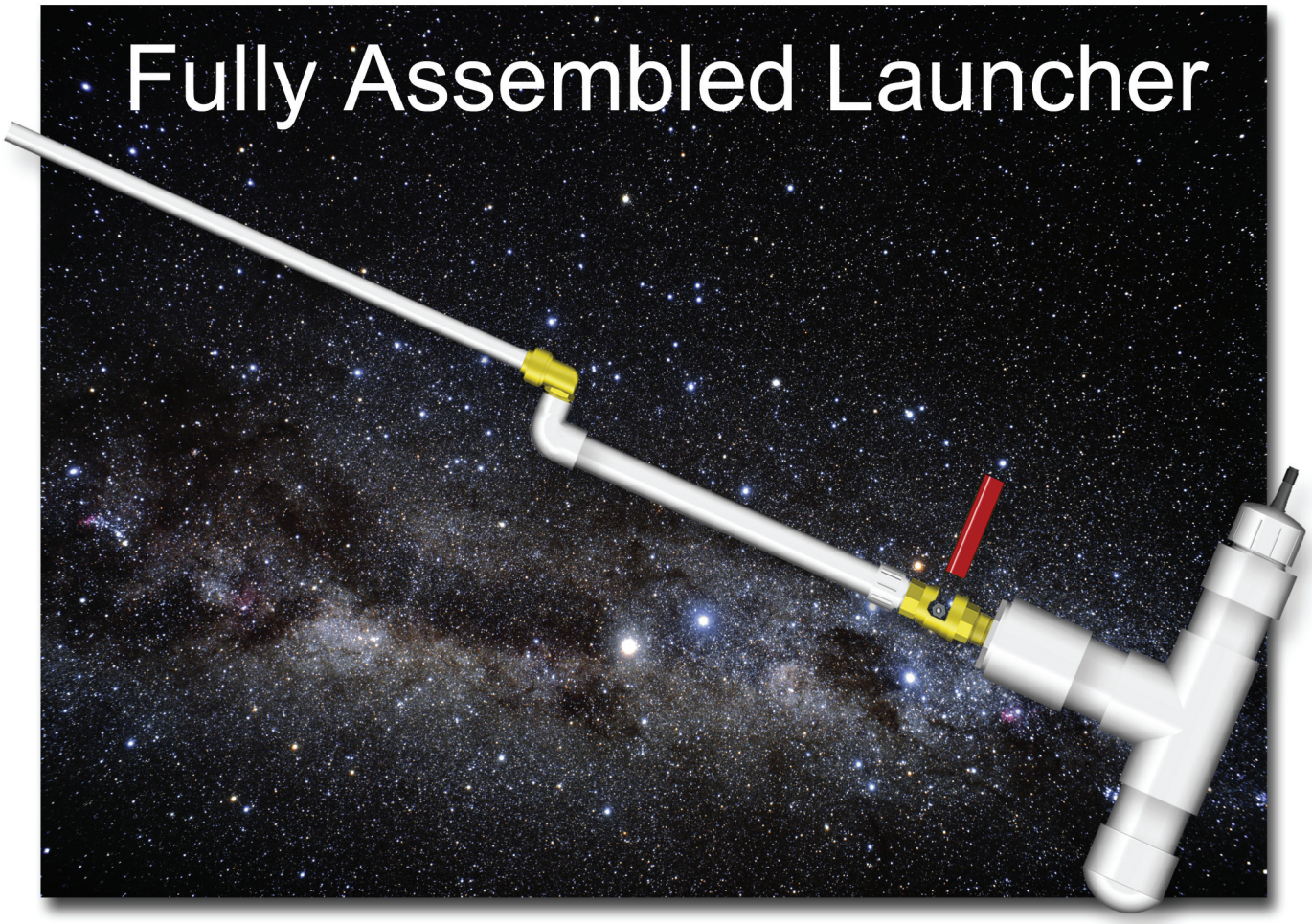
Apply PVC cement to the exposed end of the PVC pipe (K), then slide the **3/4” to 1/2” PVC 90-Degree Reducing Elbow (L)** onto the pipe. The elbow should point to the right as seen here.



Screw the SharkBite™ 1/2” X 1/2” brass 90-degree elbow (M) into the PVC elbow as seen here. Applying grease or petroleum jelly is recommended to seal and ease joint rotation (for adjusting launch angles). DO NOT OVER-TIGHTEN!



Press the **SharkBite™ 1/2 in. X 19” PEX pipe (N)** into the brass elbow. It will lock in place. **DO NOT USE PVC CEMENT!**


Fully Assembled Launcher


Launcher With Rocket
THIS SIDE UP SPACE TEAM

Building a Rocket:

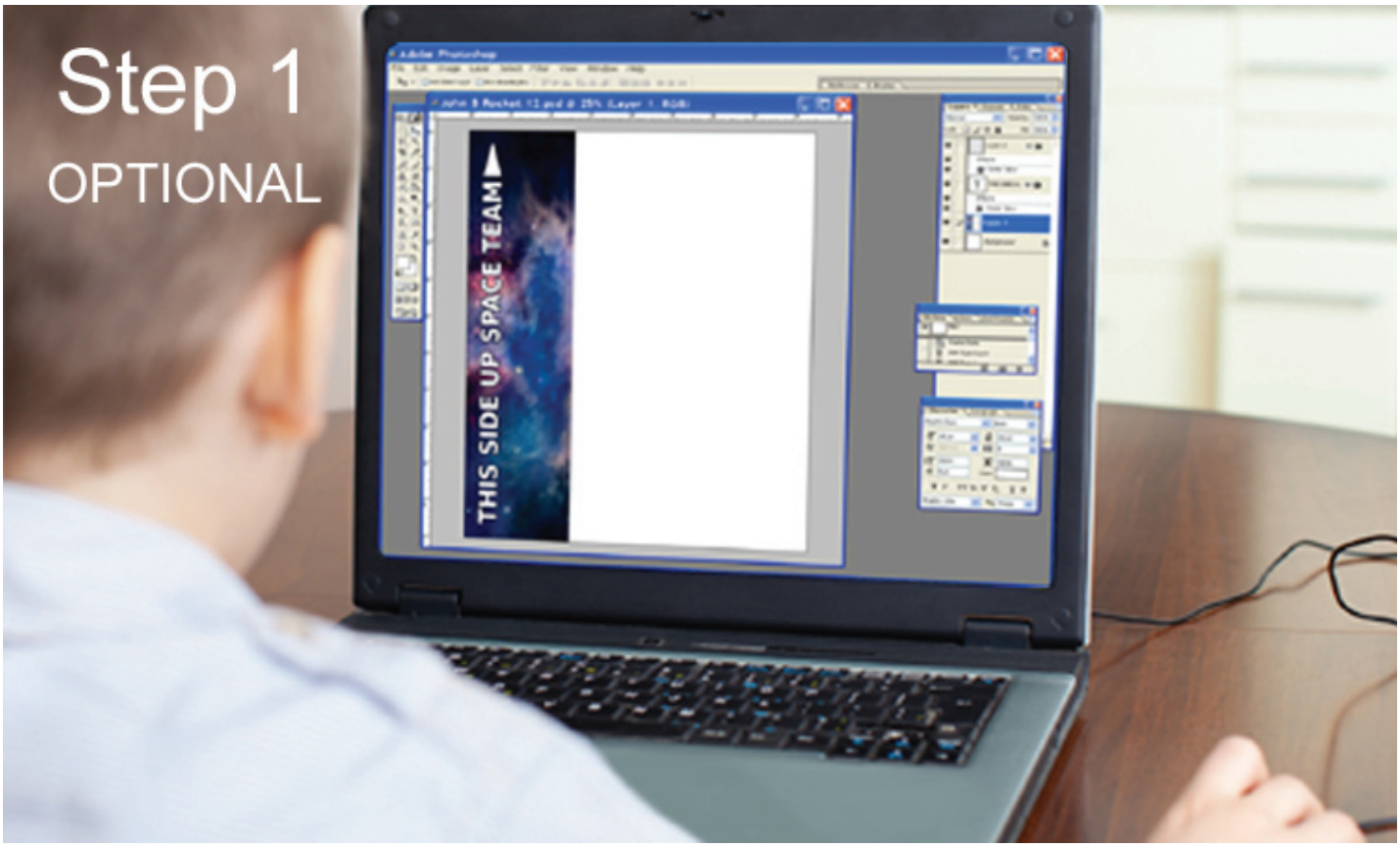
NOTES:

• The following instructions will help you build an air rocket using standard letter-size printer paper or card stock for the rocket body.

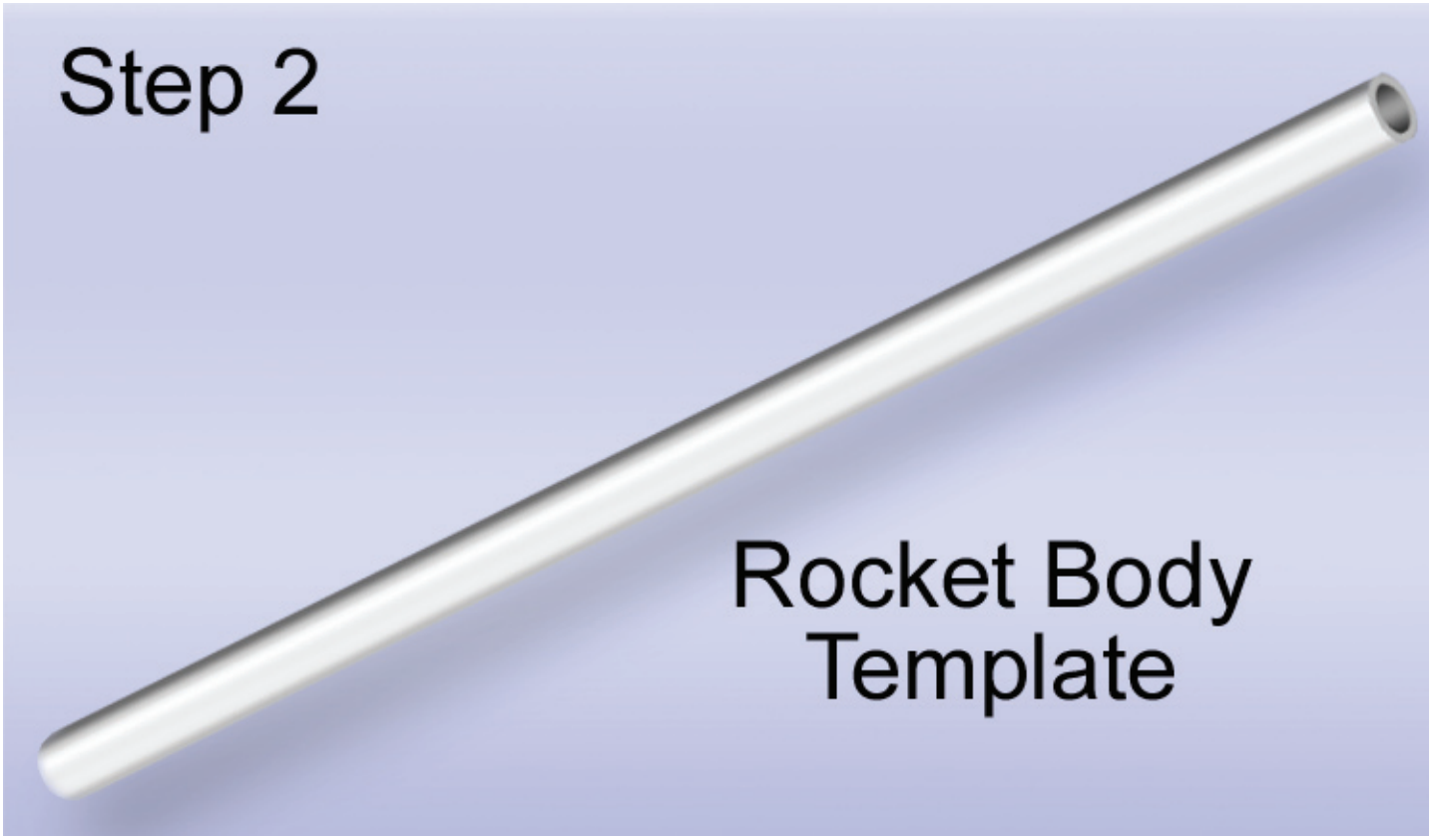
• The printer paper will be wrapped around a template (pipe) and glued. Wax paper should be placed on the pipe prior to wrapping the paper and applying glue. This step will prevent the finished rocket from sticking to the template. Additionally, the addition of wax paper (later removed) will make the rocket body's inside diameter slightly larger than the launch tube's outside diameter, allowing the rocket to easily slide on and off of the launch tube.

• A nose cone can be made from paper, balsa/bass wood, or any other material approved by the instructor.

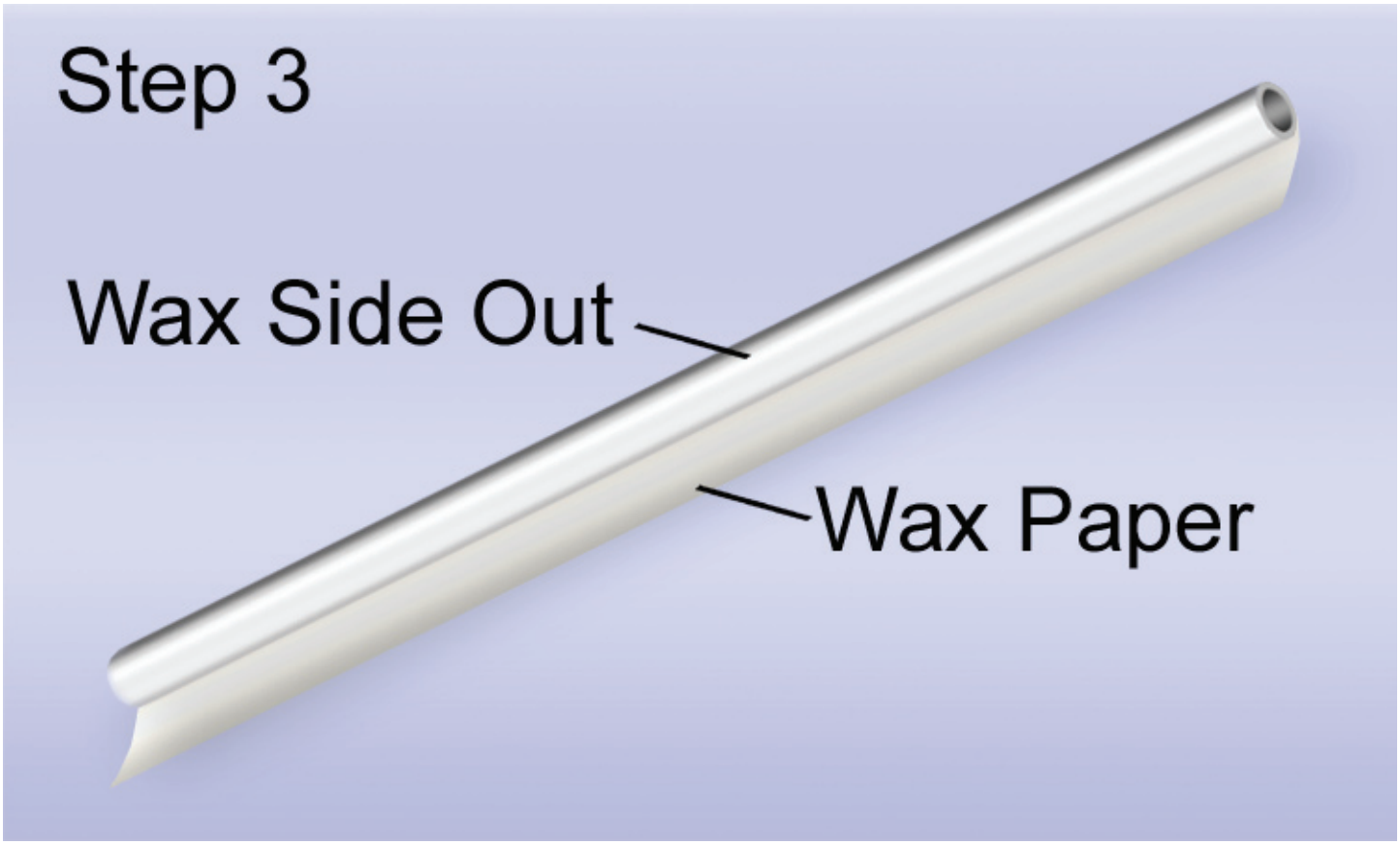
• Fins can be made from balsa/bass wood, paper card stock, or any other material approved by the instructor.



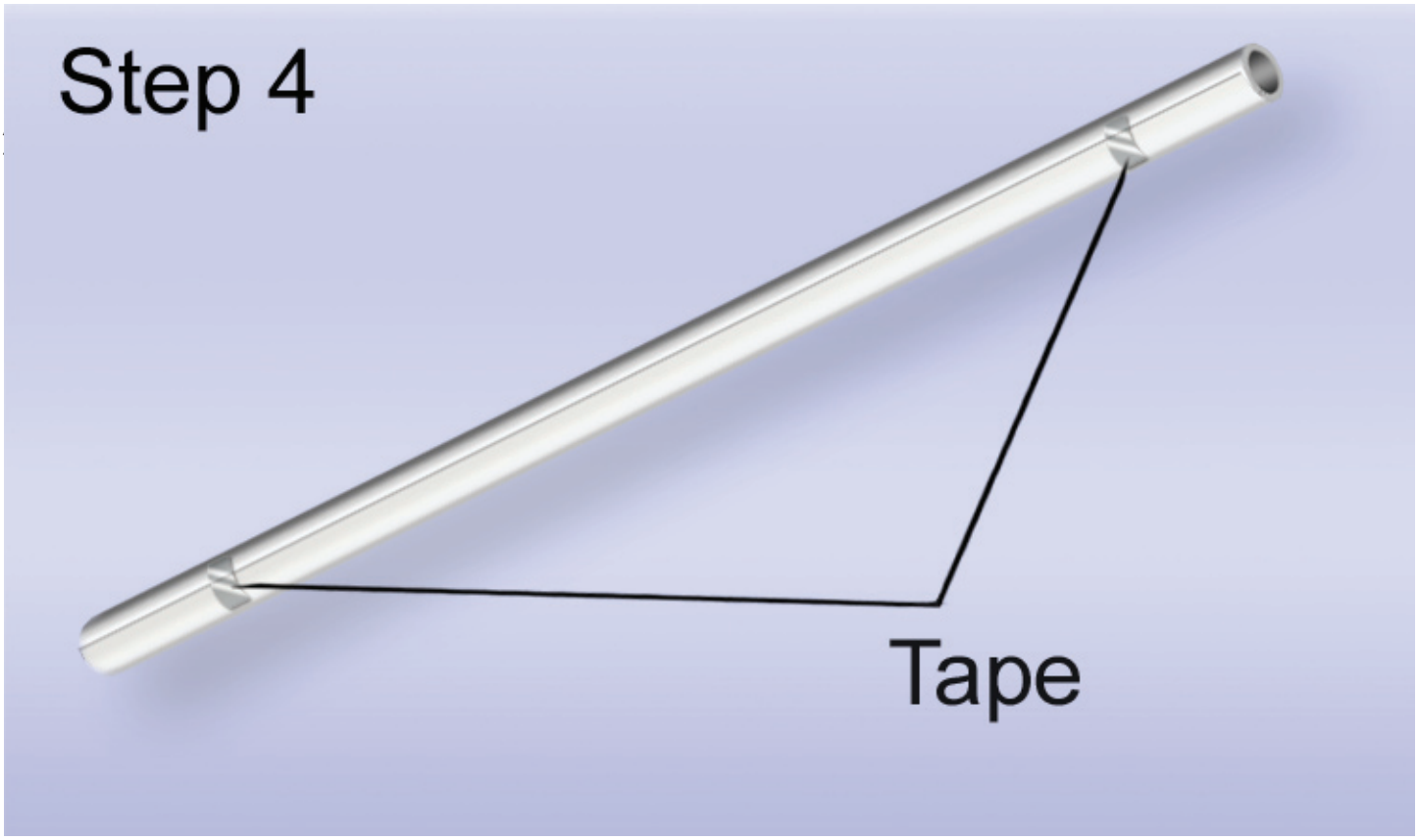
Use a graphics editing application such as Photoshop™ (seen here) to personalize your rocket. Only a portion of the paper will be exposed after rolling it onto the template. To determine the appropriate image width, measure the template's diameter, then use the appropriate formula to calculate its circumference. Print the design and proceed to Step 2.



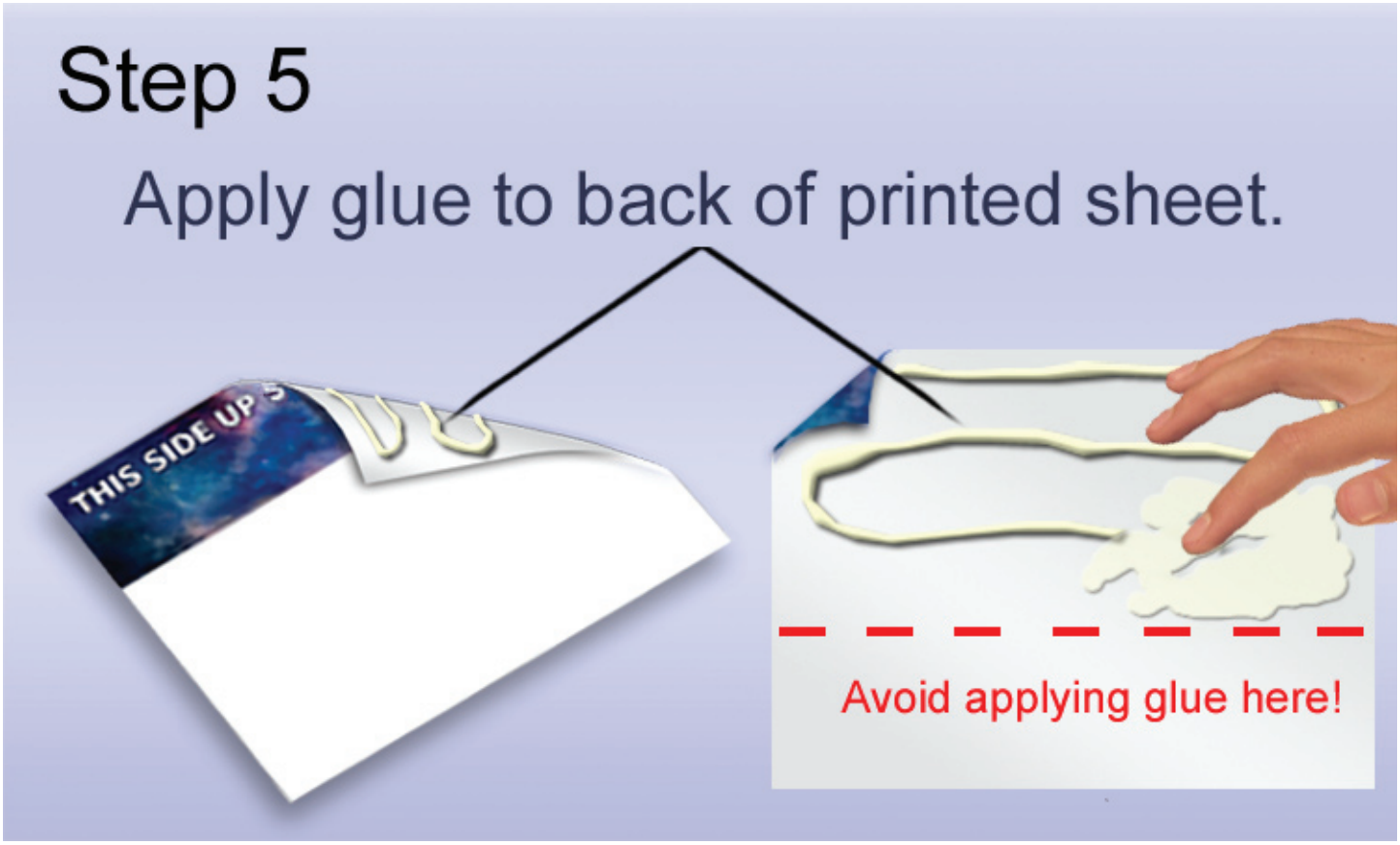
Locate the Rocket Body Template. This is simply a piece of white 1/2" PVC pipe approximately 14" long. The template is the same diameter as the pneumatic launcher's "Launch Tube."



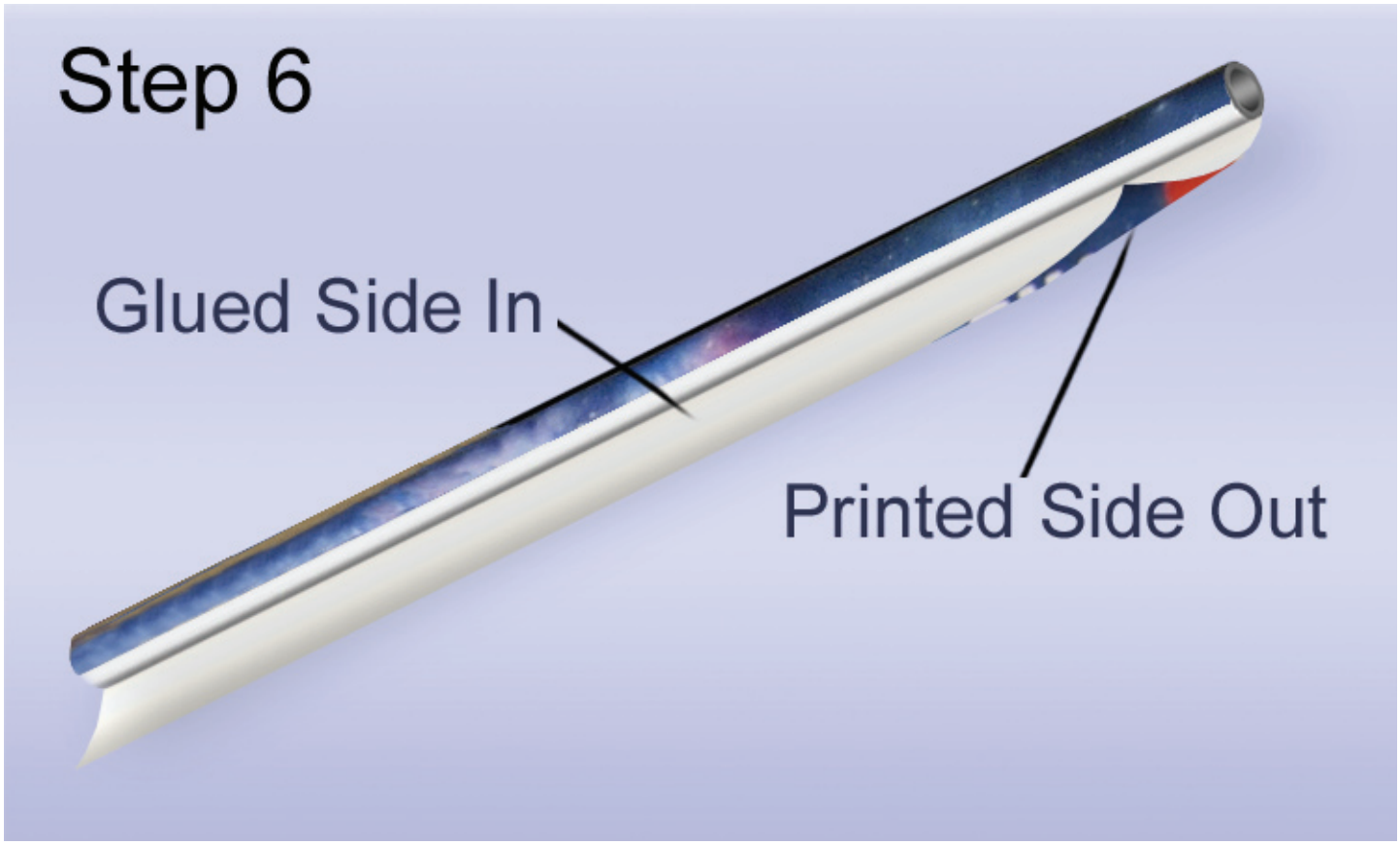
Wrap a piece of wax paper several times around the rocket template (1/2” PVC pipe) to create a non-stick layer between the rocket body and the template. This will also force the rocket body to be slightly larger than the launch tube. The completed rocket body should easily slide on and off the launch tube.



Tape the edge of the wax paper in two places to hold it in place for the next procedure.



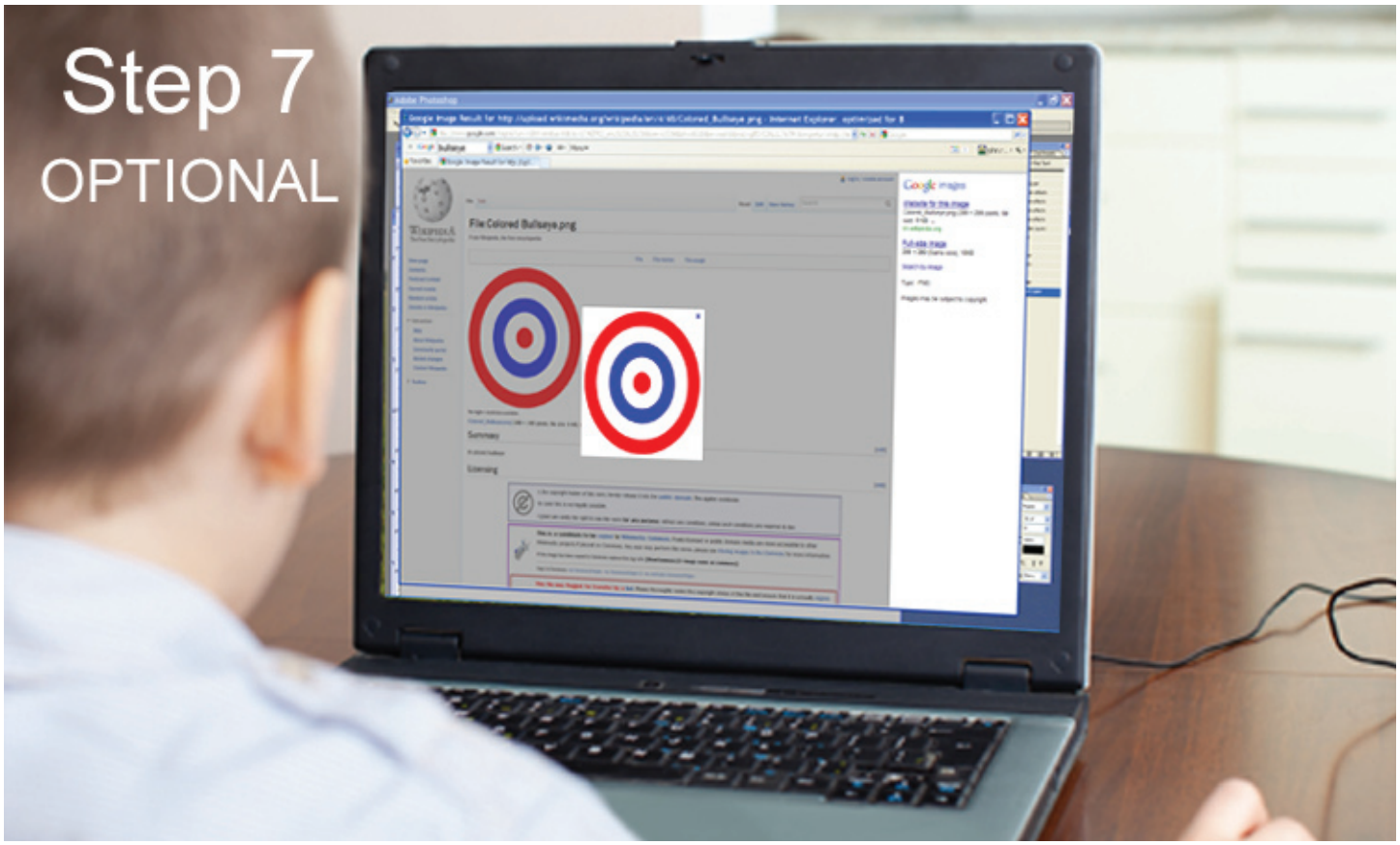
Apply clear-drying craft glue (Elmers™) to the back of the rocket body sheet opposite the graphic (your printed design, if any). Use a brush or your finger to spread and smooth the glue over the upper 2/3 of the sheet.



Starting with the non-glued edge, carefully roll the printed sheet around the wax-paper covered “Rocket Body Template.” The rocket body should be uniform with no major wrinkles, but should still easily slide on and off the template. The rocket body will be soft at first, so be careful. If possible, allow the glue to harden while the body is still on the template.

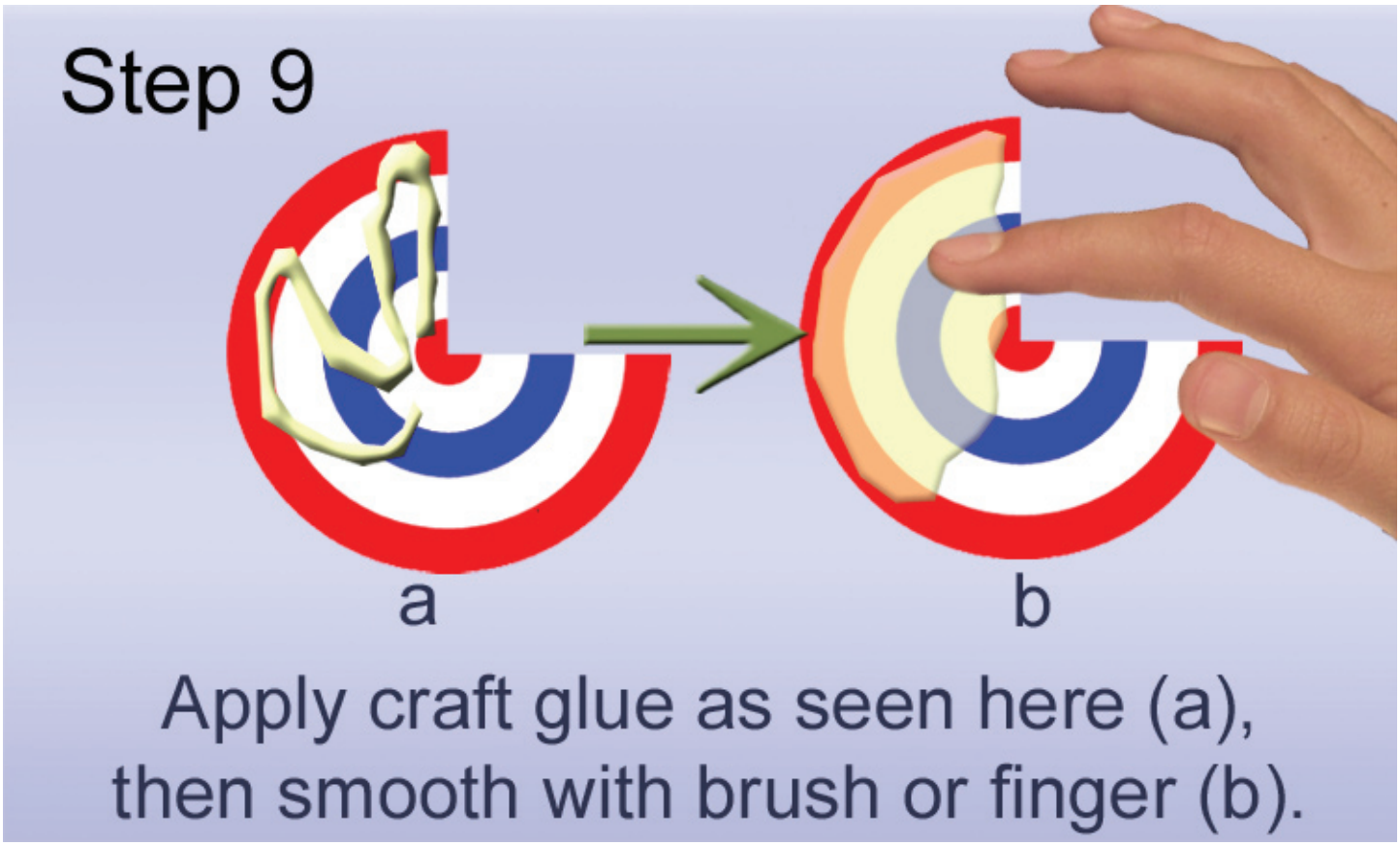
Making a Paper Nose Cone

Nose cones of various designs can be purchased from some hobby suppliers, or they can be made from other materials such as wood, clay, rubber, and paper. These instructions illustrate how to make a nose cone from inexpensive paper.

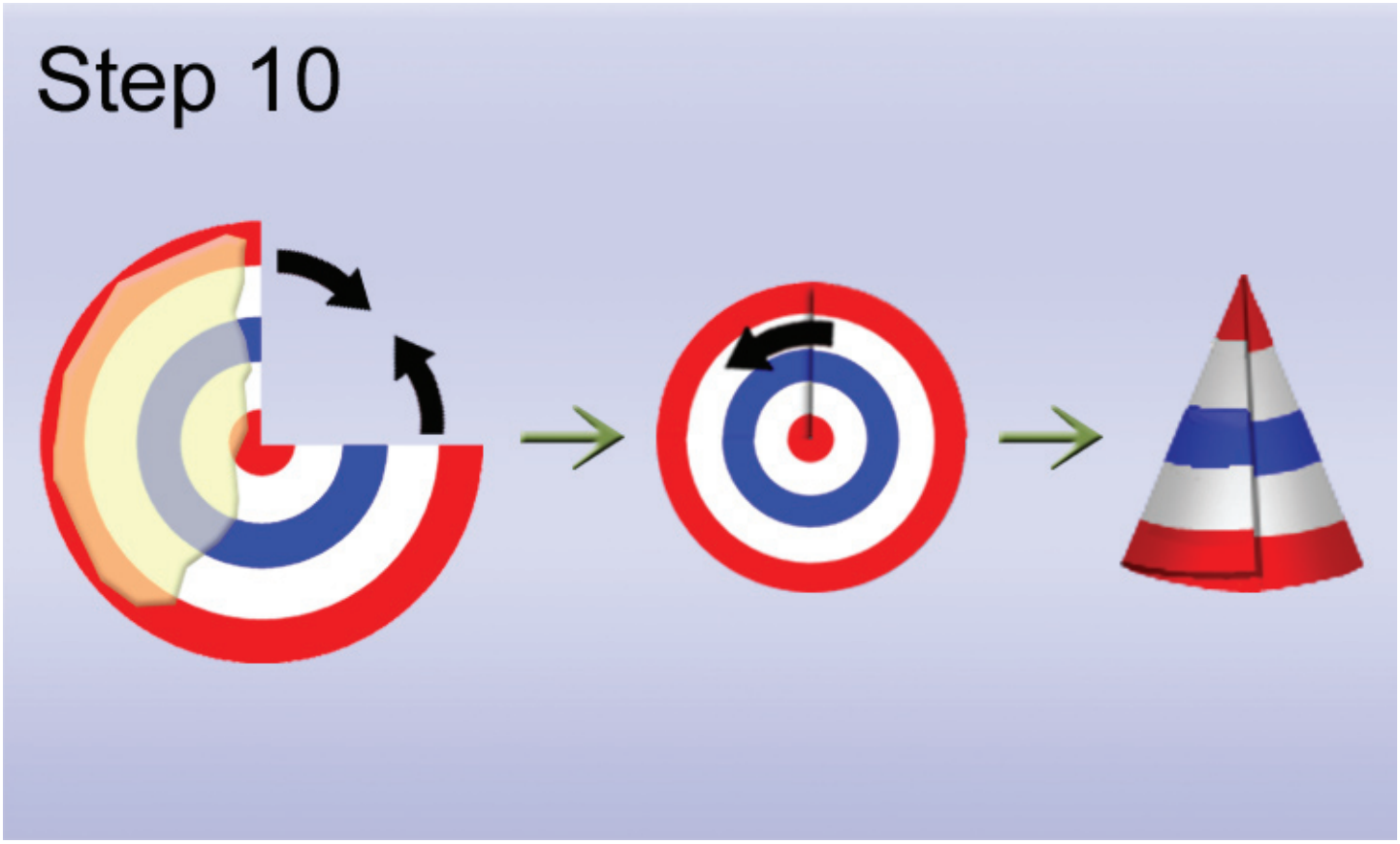


If you like, you can customize your nose cone with graphics you have created or found on the Internet. Print the pattern on standard printer paper or card stock.

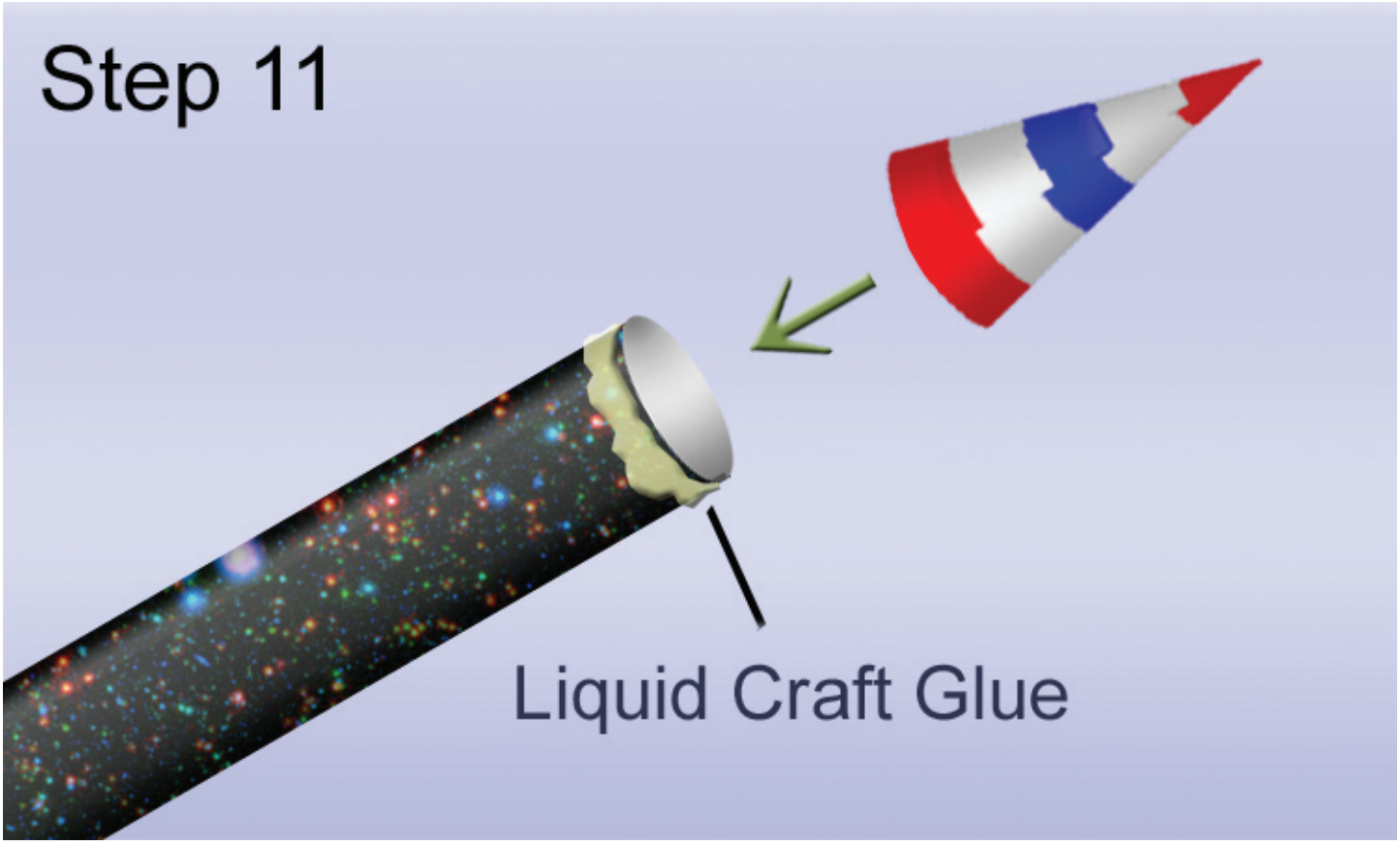
Cut the pattern in a circular shape, then remove approximately 1/4 of the pattern as seen here.



Apply a conservative amount of liquid craft glue to 1/2 of the remaining nose cone pattern as seen here. Use a brush or your finger to smooth the glue. Proceed quickly to step 10.



Pull the two straight edges together and overlap the non-glued portion with the glued portion forming a cone. Overlap the seam until the cone's bottom is slightly larger than your rocket body's diameter. Allow the glue to set before continuing.

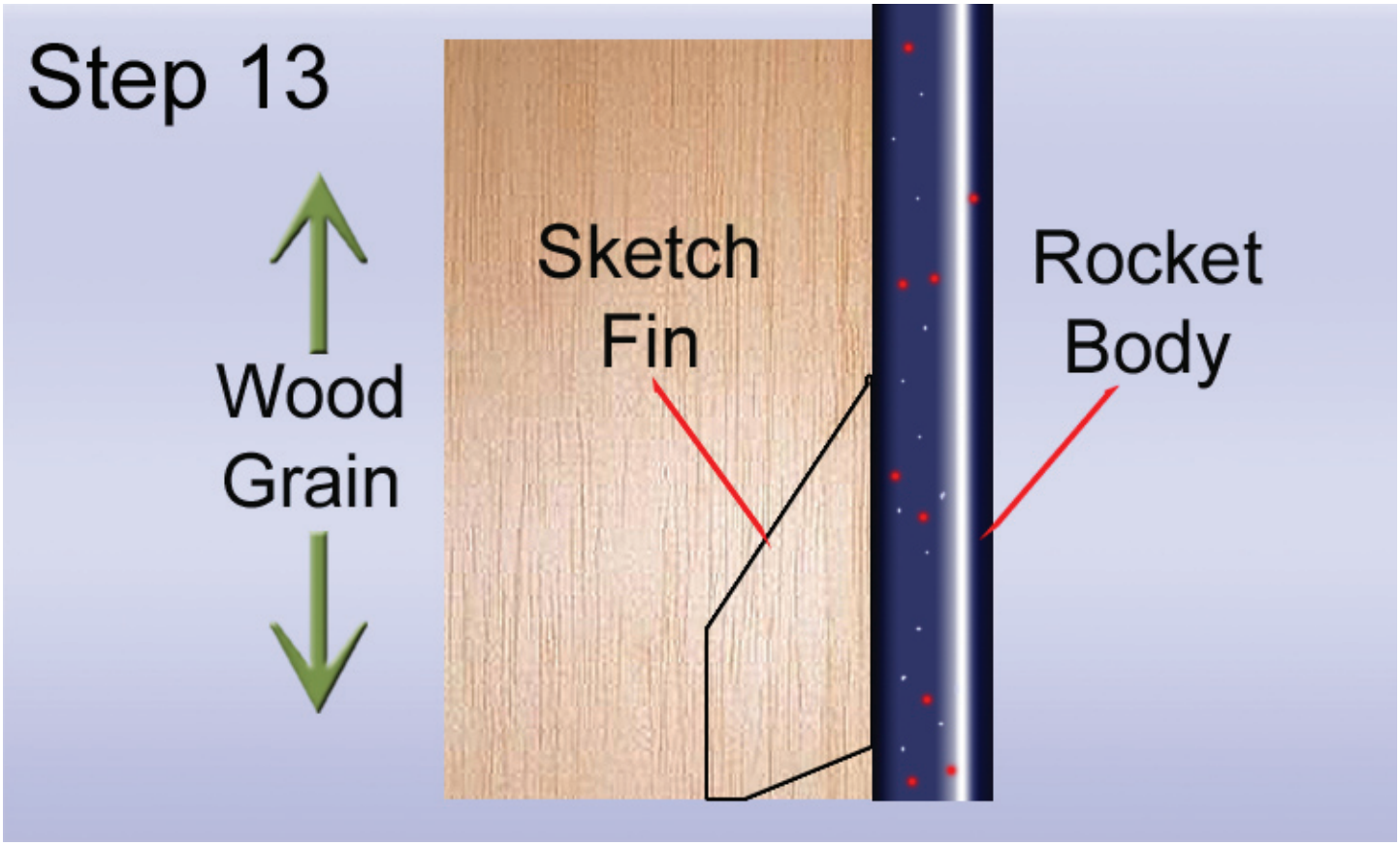


Liberally apply glue around the top end of the rocket body, then attach the nose cone being careful to keep it as straight as possible. A crooked nose cone can cause serious trajectory issues when launching. Allow the glue to set.

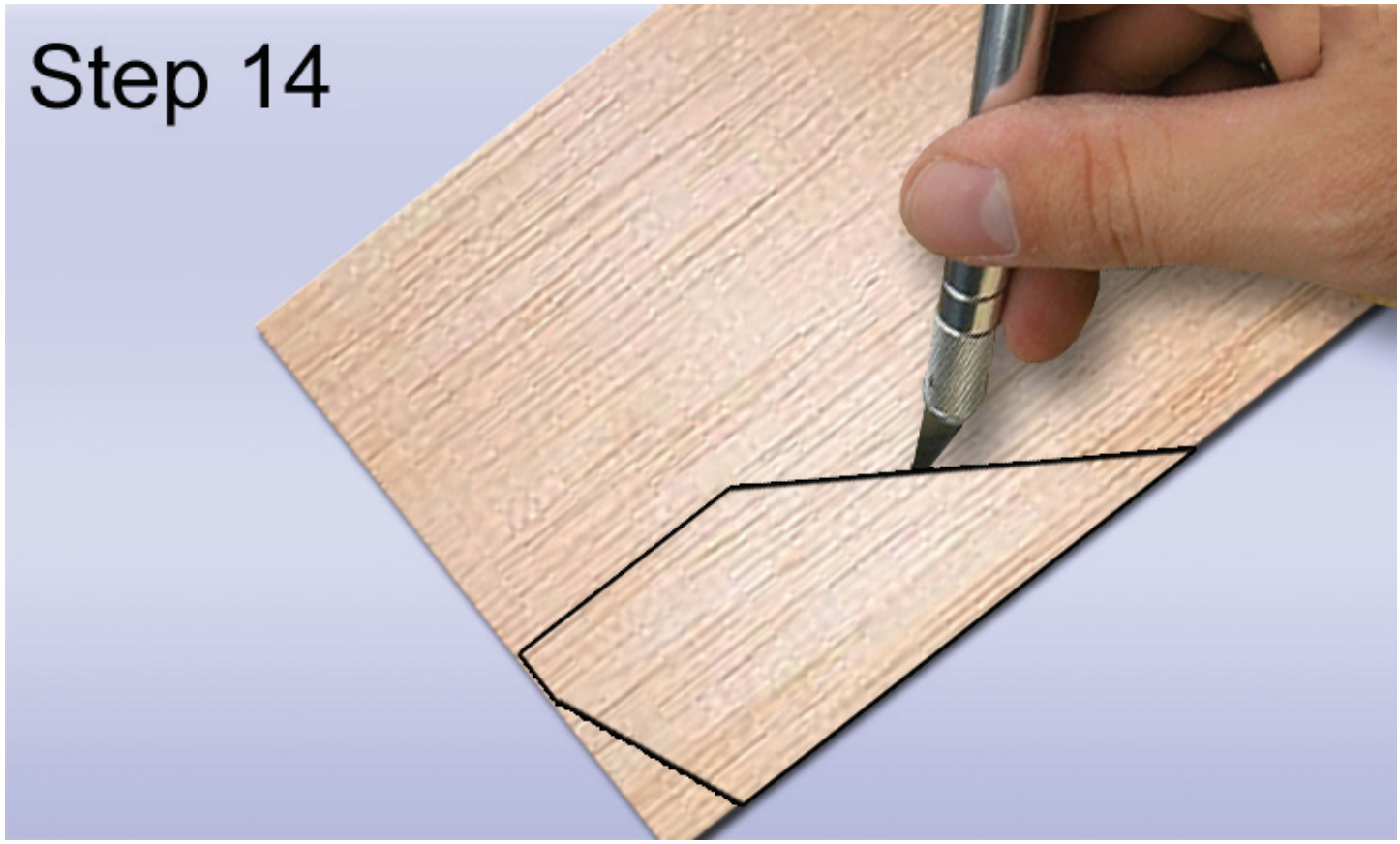
Adding Fins to the Rocket Body

Fins can be made from lightweight material such as balsa wood, foam, sheet plastic, cardboard, laminated printer paper, and card stock. These instructions illustrate how to make and attach balsa wood fins.

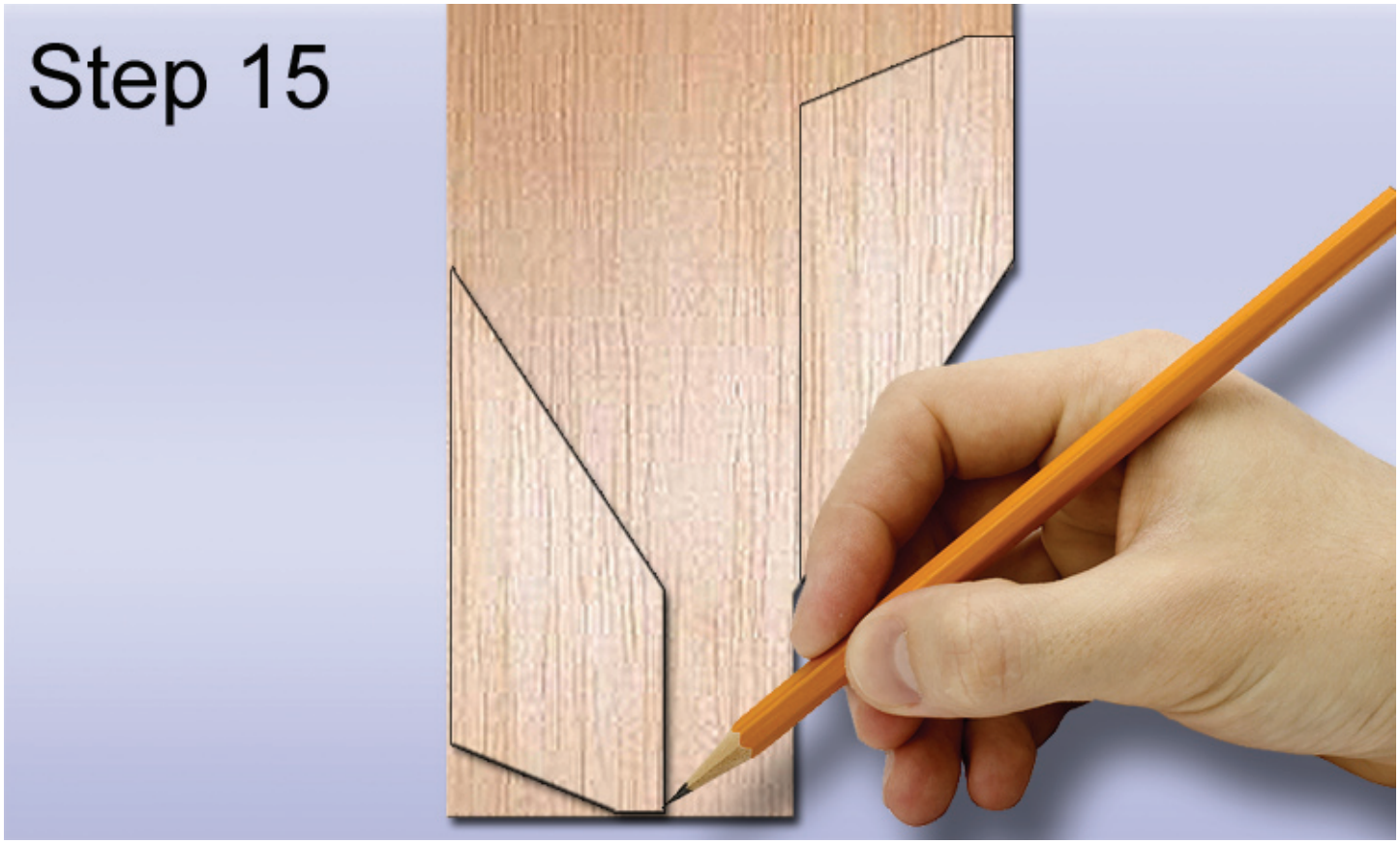
Before cutting any material, us the Internet or other sources to research various model rocket fin designs. When you have selected a design, decide the number of fins you wish to add to the rocket. Three to four fins are recommended.



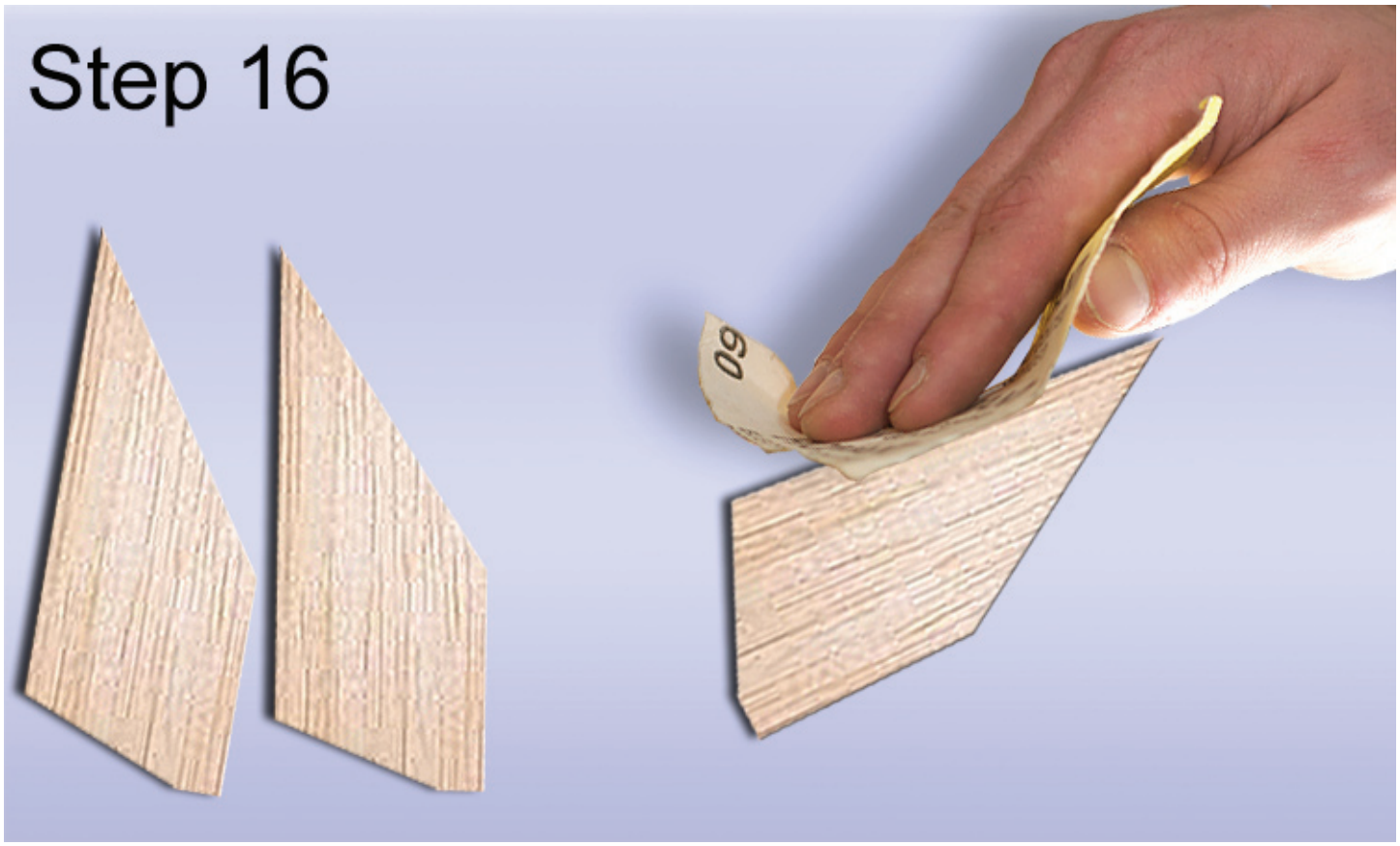
Use a pencil to sketch one of your fin designs onto the available fin material (balsa wood in this illustration). It's preferable to cut the fin with the wood grain running parallel to the rocket body. <<SKETCH ONLY ONE FIN>>
Note - Be sure to leave enough material for additional fins.



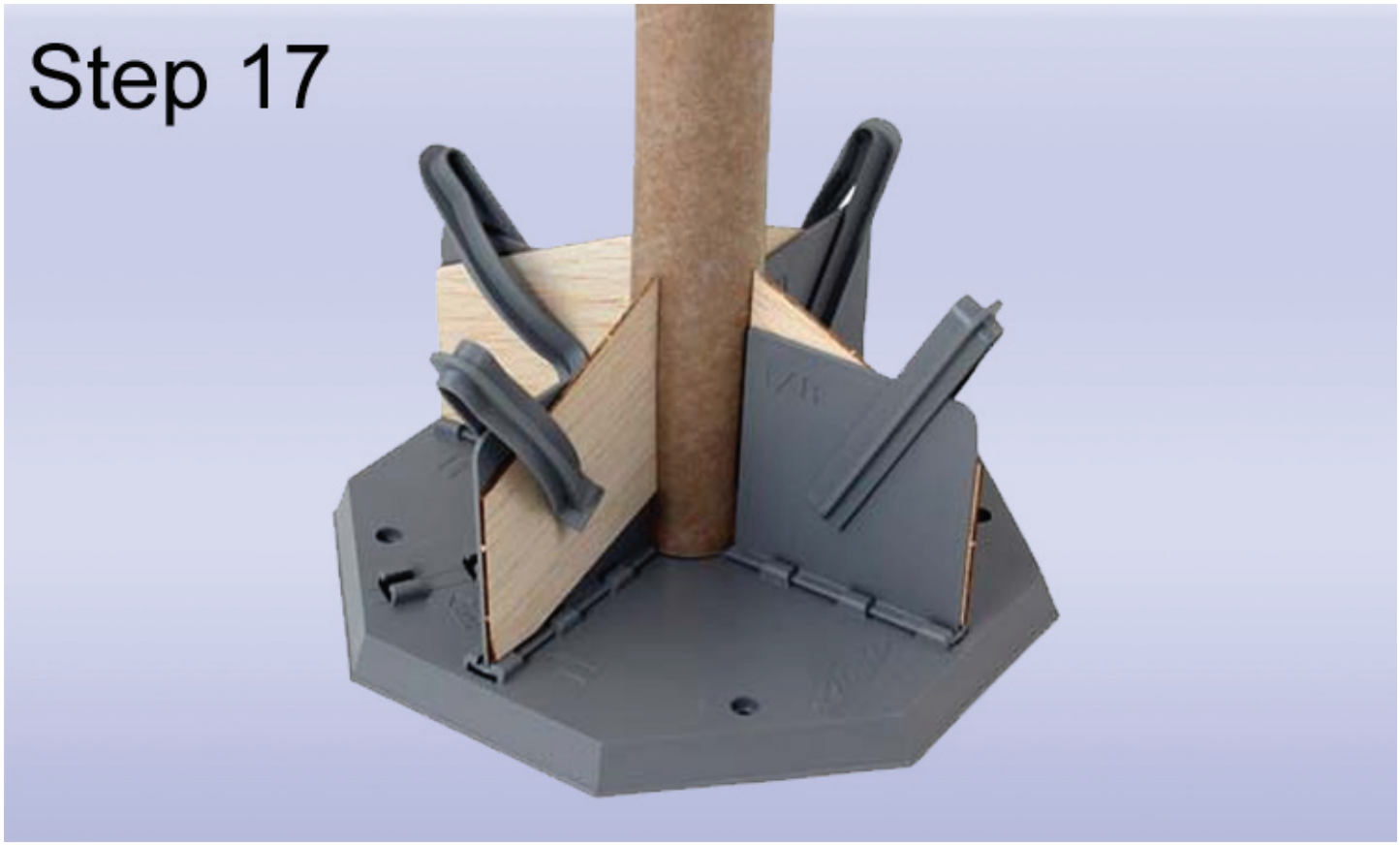
Carefully use a hobby knife or similar tool to cut one fin from the material. Cut only one fin. You will use this fin as a template for additional fins.



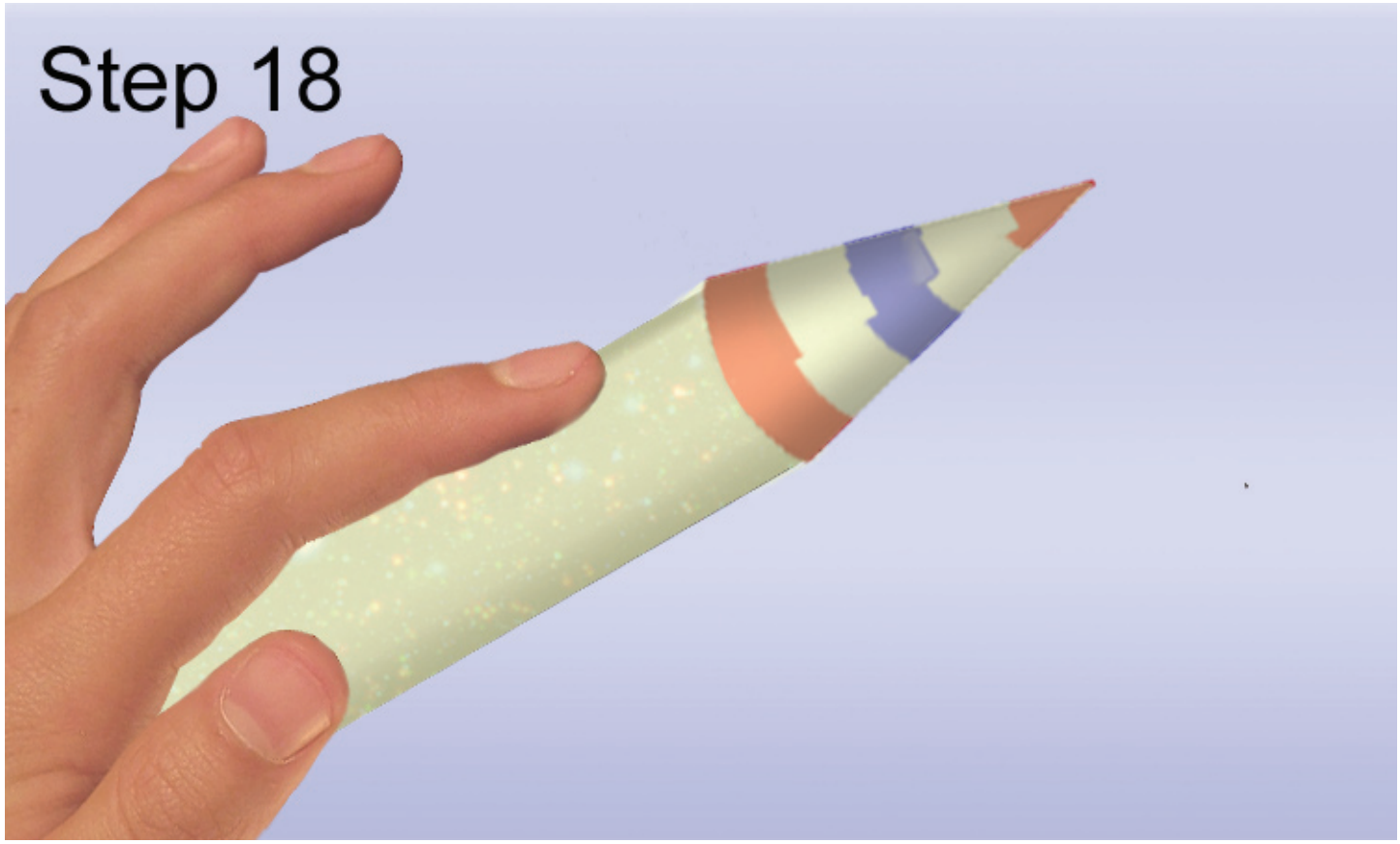
After cutting the first fin from the material, use it as a template for the additional fins. Pay attention to the direction of the wood grain. The grain of all fins should be going in the same direction.



After cutting all the fins from the material, clean them up with sandpaper. You may wish to bevel or round outside the corners, but maintain a straight edge where the fin attaches to the rocket body.



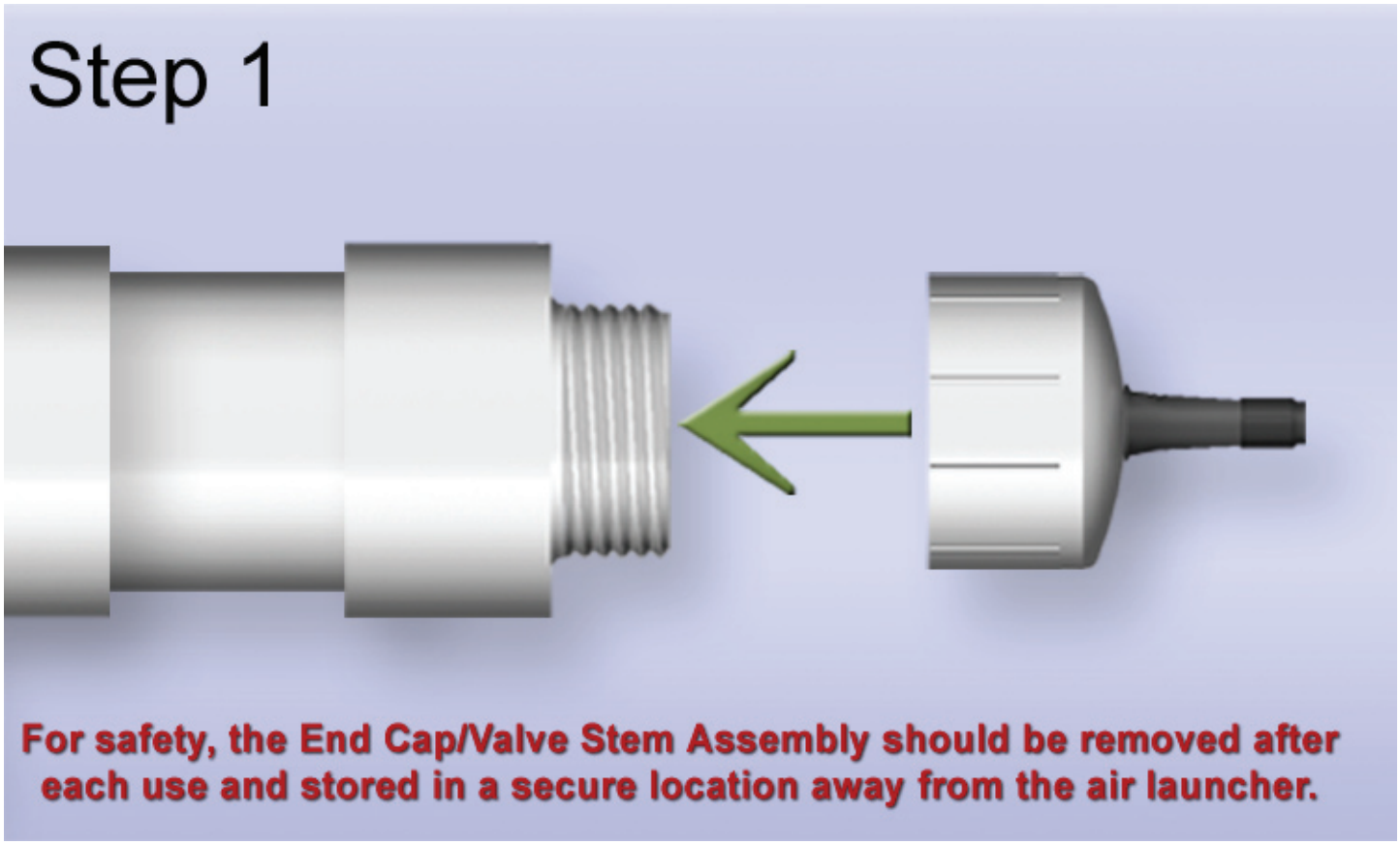
There are numerous ways to accurately attach fins to a rocket body. Fin alignment is critical for good launches. Pictured here is the Estes Fin Alignment Guide which holds three or four fins in alignment while being glued to the rocket body. Instructions are included with the fin alignment guide, but operation is pretty straightforward.



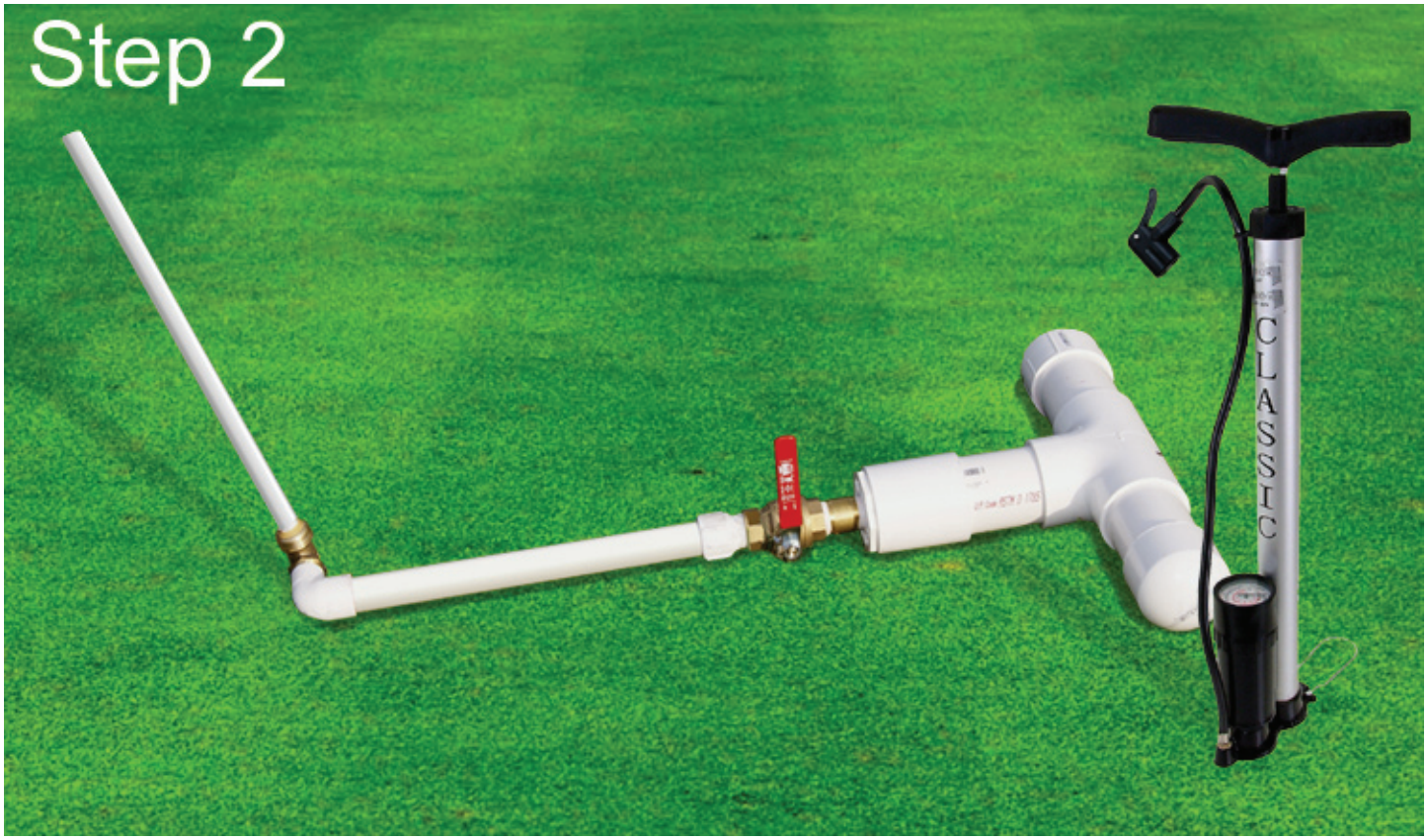
After attaching the fins, allow the glue to set, then apply a coat of hobby glue to the entire rocket from top to bottom. Allow the glue to dry completely. Repeat this step two to three times until the rocket body and nose cone are rigid.

ATTENTION !

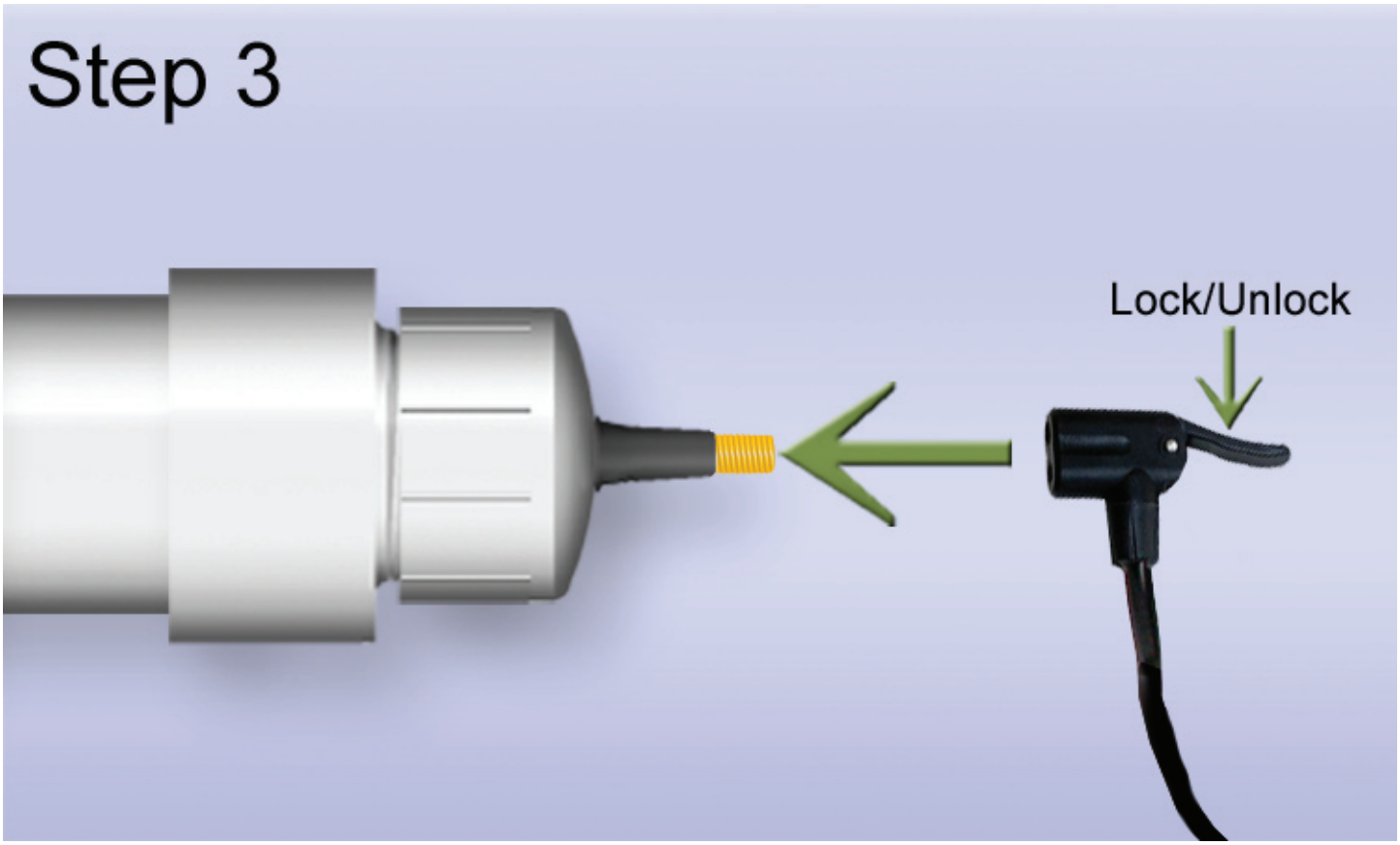
- These instructions demonstrate how to launch a rocket or aircraft using an air launcher.
- USE COMMON SENSE!
- Establish a safe launch site prior to using the device.
- Never point the rocket toward people, animals, vehicles, or buildings.
- Never put more that 30 lbs (psi) of air pressure in the launcher.
- BE AWARE! Rockets can travel HUNDREDS OF FEET! Experiment with low pressures first.
- Rockets can injure on the way up and the on the way back down. BE CAREFUL!
- For safety, remove the end cap that houses the valve stem when the device is not in use.
- THIS DEVICE MUST BE USED BY A RESPONSIBLE ADULT.



If the End Cap/Valve Stem assembly was previously removed (for safety), place the assembly on the air launcher's appropriate threaded adapter. Using grease or petroleum jelly on the threads helps the seal and makes removing and replacing the assembly much easier.



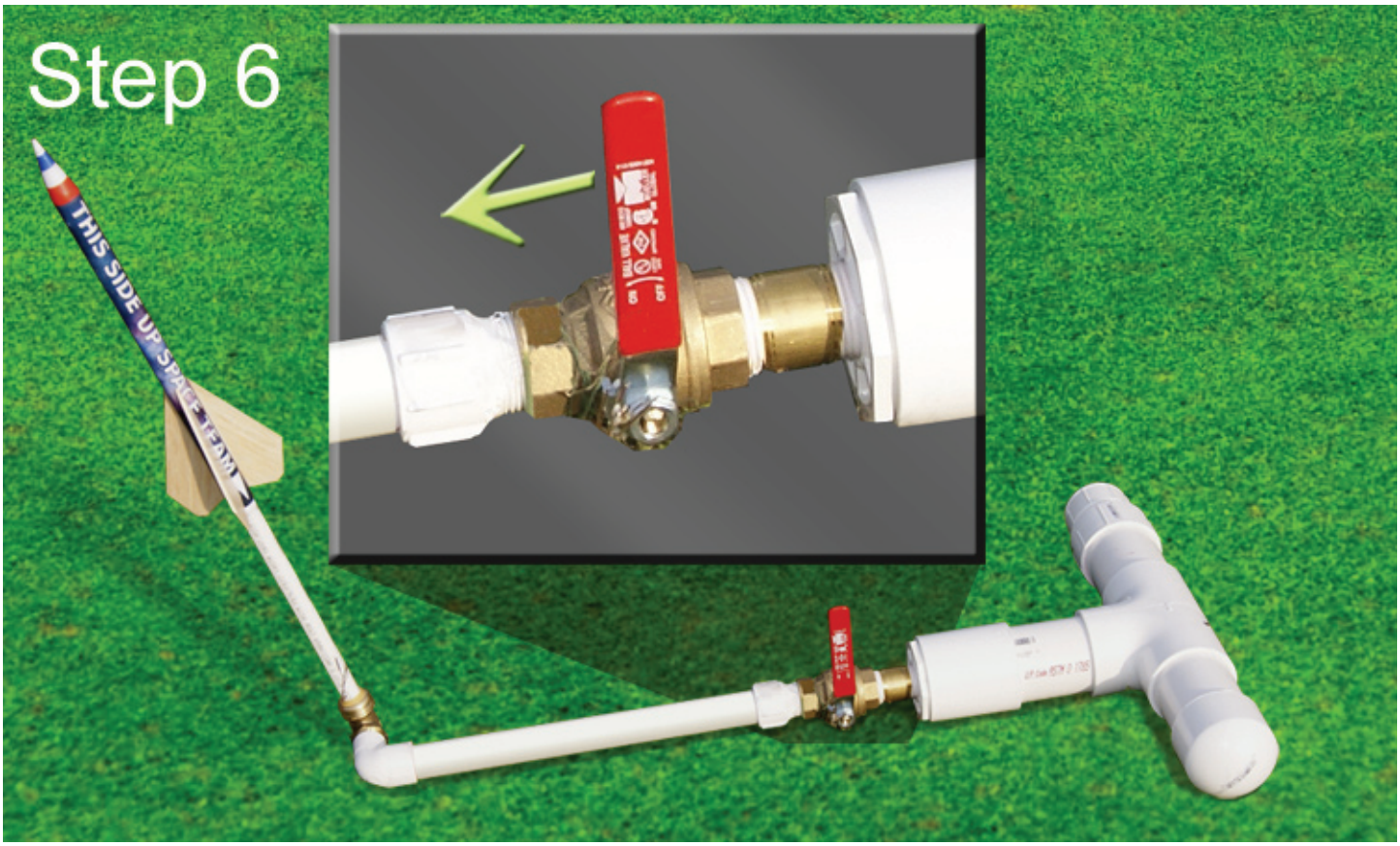
Transport a bicycle pump and the air launcher to a remote launch site. Point the launch tube up and at a slight angle away from the rear of the launcher. DO NOT PLACE A ROCKET ON THE LAUNCH TUBE YET!



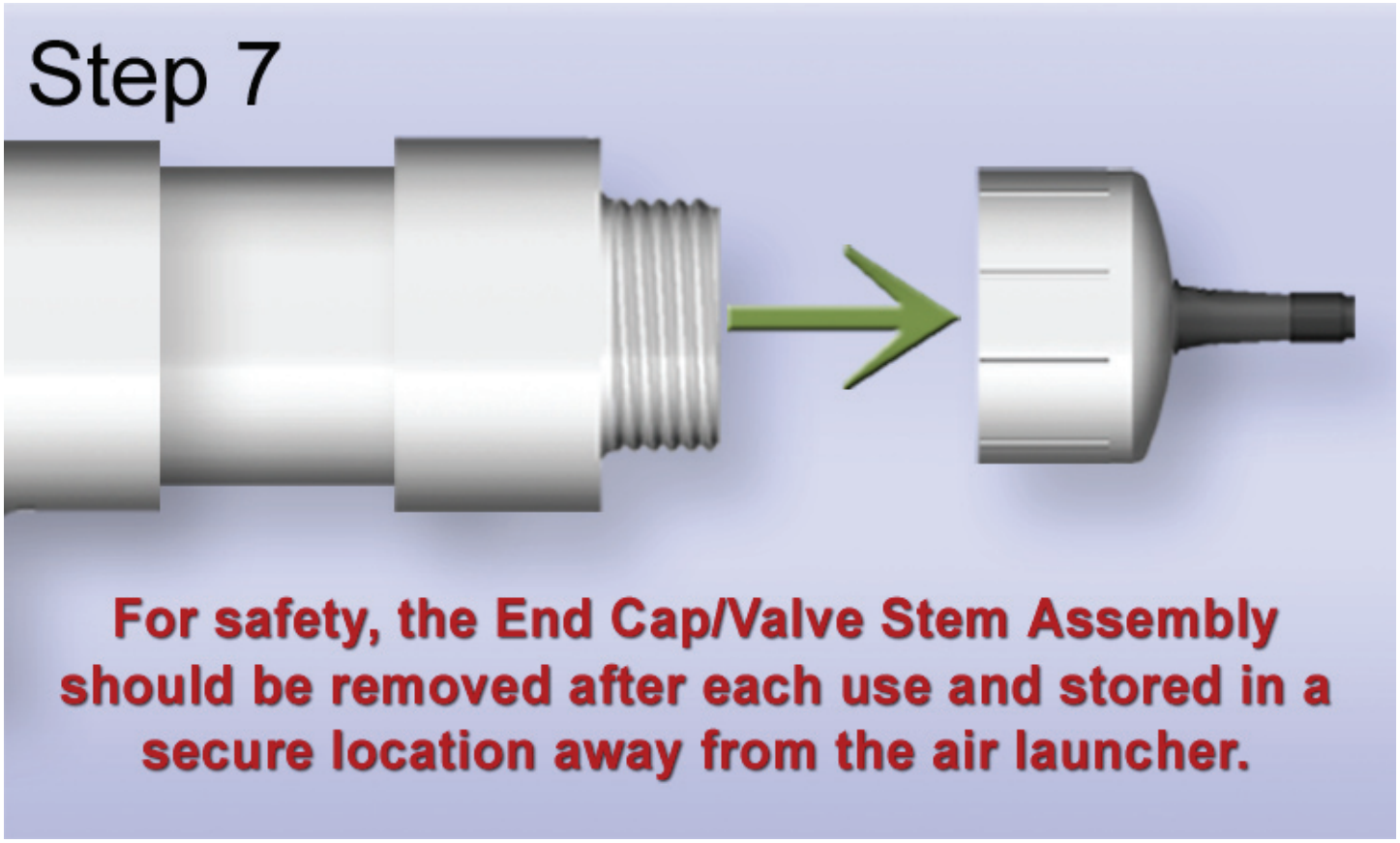
Place the bicycle pump's "locking air chuck" onto the valve stem and lock in place. Note that some pumps lock in the up position, and some lock in the down position.

Operate the air pump to add pressure to the air launcher's pressure chamber. Testing the device with just a few pounds of pressure is strongly recommended. Add less than 10 pounds, the first time. You might be surprised at the result. WARNING - DO NOT TEST THE AIR LAUNCHER INSIDE!

To test rockets at full launch, you must first verify you have the space. Rockets can travel 300+ feet vertically, if launched diagonally, or if the wind is strong, rockets can easily travel much further. NEVER EXCEED 30 PSI when adding air to the pressure chamber. Always have spectators stand well behind the launcher and set the launch angle by rotating the launching tube. For accuracy, use a protractor.



When you are ABSOLUTELY SURE everyone is clear and that the launcher is pointing away from any people, animals, buildings, and vehicles, press the ball valve lever to the “open” position.



When you have finished launching rockets, always be sure to remove the End Cap/Valve Stem Assembly and store it somewhere safe and away from the rest of the launcher.