

15. Hippo

This toy is designed to be moved along the floor by hand rather than pulled by a string or pushed by a stick. The mouth of the hippo opens and closes as it is pushed. This movement is created by alternating dowels on the wheels that lift the head up, then let it fall.



Figure 15 – 1. Hippo

Materials and Tools

The following tables give the wood cut list and other parts. Figure 15-2 shows the parts explosion and Figure 5-5 gives the dimensions of the body and head sides. Special tools needed to construct this toy are noted below, followed by the step-by-step instructions for building the hippo.

Wood Cut List

Part	Material	Size (thickness, width, length)	Qty
Body	Hardwood (1), (2)	1 1/4" x 4" x 9 3/4"	1
Head (sides)	Hardwood (2)	1/4" x 3 1/2" x 5"	2
Upper head spacer block	Hardwood (2), (5)	3/4" x 1 7/16" x 3 1/4"	1
Lower head spacer block	Hardwood (2), (5)	3/4" x 1 7/16" x 1 1/4"	1
Wheel blanks	Baltic birch (3), (4)	1/2" x 3" x 3"	4
Teeth	Dowel	3/8" x 7/8"	2
Axles	Dowel	3/8" x 3 3/4" (cut-to-fit)	2
Drive pegs	Dowel	3/8" x 3/4"	2
Rear wheel spacers	Dowel	3/4" diameter x 1/2"	2

(1) If using wood thicker than 1 1/4" for the body, the thickness of the two head spacers will need to be adjusted.

(2) Use the same type of wood for all these parts. Mahogany or walnut will look good.

(3) Use Baltic birch plywood or any hardwood.

(4) These square blanks will be used to make a wheel 2 1/2" in diameter. Alternatively, these wheels can be purchased. Several toy part suppliers offer them as 2 1/2" flat slab wheels (3/4" thick) with a 3/8" center hole. (See Appendix for list of suppliers.)

(5) The width of the spacers needs to be 3/16" greater than the thickness of the body.

Other Parts

Part	Material	Size	Qty
Eyes (head pivot)	Axle peg	7/32"	2
Washers	Plastic or steel	1/4"	2
Tail	Twisted nylon rope	1/4" diameter x 1 1/2" long	1

Tools Required

- Woodworking tools and supplies (see Chapter 2, pp. 14-15)
- Special tools for this toy:
 - Twist drill bits: 13/32", 15/64", 1/4", and 3/8"

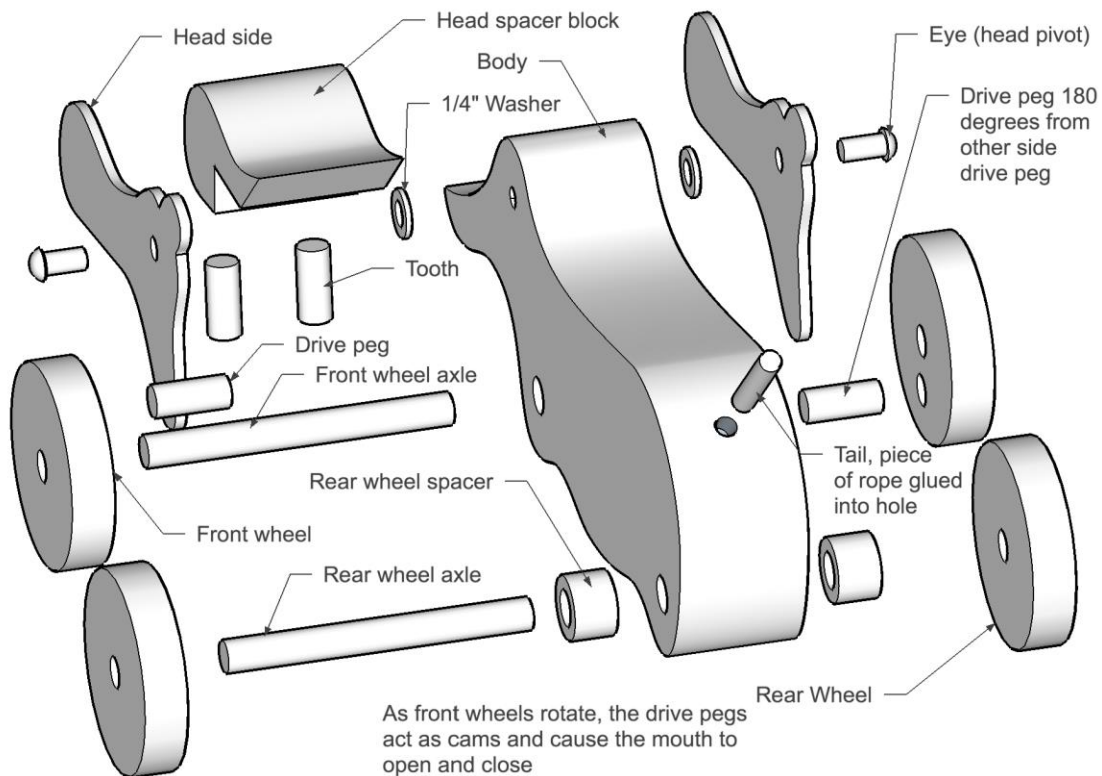


Figure 15-2. Parts Explosion

Plans and Steps

Body

1 – Design. Use the template at the end of this chapter (Figure 15-6) to transfer the outline of the hippo's body onto the wood blank. Mark the holes on the body with a center punch or a nail.

2 – Holes. Drill the three holes in the side of the body. Each is a through hole. The two axle holes are made by using a $1\frac{3}{32}$ " drill bit and the hole for the eye axle peg (jaw pivot hole) is made using a $\frac{15}{64}$ " drill bit.

3 – Shape. Cut out the body to within $\frac{1}{32}$ " to $\frac{1}{16}$ " of the outline. Sand to the outline. Round over the edges to a generous radius, either by

sanding or using a $\frac{1}{4}$ " roundover bit. Then sand all surfaces and edges up to 150 grit sandpaper.

Router Safety

DO NOT USE a router to round over edges of toy parts **UNLESS** the router is stationary, that is, attached to a router table. See Ch. 18, p. 158.

4 – Attach tail. Drill a $\frac{1}{4}$ " diameter hole $\frac{1}{2}$ " deep on the back rear of the hippo for the tail. Cut a piece of $\frac{1}{4}$ " twisted nylon rope $1\frac{1}{2}$ " long and cauterize the ends so that they do not unravel. Glue the tail into the hole.

Wheels

1 – Make or purchase. The hippo uses wheels that are 2 1/2" in diameter with a 3/8" center hole. These wheels can be purchased or made. The following steps assume the reader has made and rounded over the wheels.

Making Wheels

See Chapters 18, 19, and 20 for techniques and jigs to cut out, sand, and roundover wheels.

If the wheels have been purchased, the following instructions might need to be slightly modified, depending on the size and type of wheels purchased.

2 – Front wheels. Drill an off-set 3/8" hole on the inside of each of the two front wheels for the dowel that activates the head/mouth. The center of this hole should be 5/8" from the center of the wheel (see Figure 15-3), and it should be 3/8" deep. Be certain to clamp each wheel securely before drilling.

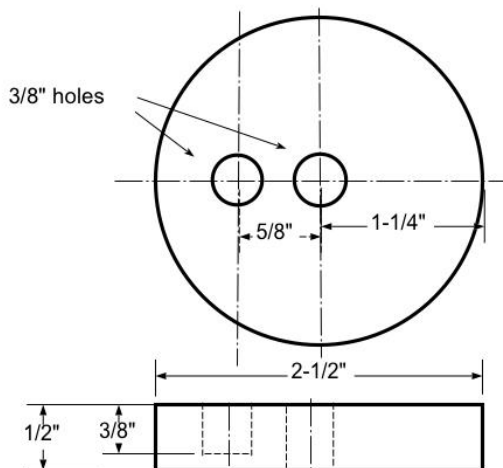


Figure 15-3. Front Wheels

Jig to Hold Wheels for Drilling

See Figure 13-4 (p. 107) described on p. 106.

3 – Drive peg. Cut two 3/4" lengths from a 3/8" diameter dowel. Put glue into each of the off-set holes drilled into the front wheels and insert a drive peg into each hole. Wipe off any excess glue. The drive pegs should extend out of the hole 3/8".

4 – Front axle. Assuming the body of the hippo is 1 1/4" thick (if thicker or thinner adjust the following accordingly), cut a piece of 3/8" diameter axle 3 1/2" long. Put glue into the 3/8" center hole of one of the front wheels and insert the axle from the inside of this wheel (the side that has the drive peg) until it is flush with the outside. Wipe off any excess glue from the outside of the wheel and let the glue set.

5 – Dry assemble front axle. Insert the wheel and axle that has been assembled into the hole in the front of the hippo's body and put the second front wheel onto the axle extended through the body. Adjust the position of the second wheel such that there is about 1/16" space between each drive peg and the body of the hippo. Place a mark where the axle extends past the outside of the second wheel. Take the second wheel off and trim the axle at the mark. Set aside these two wheels, one with the axle attached. Finish will be applied to them before final assembly.

6 – Rear axle spacers. To keep the rear wheels the same distance from the hippo's body as the front wheels, it will be necessary to put spacers on the rear axle. Cut two spacers 1/2" in length from a piece of 3/4" dowel. Drill a 13/32" hole through the center of each spacer.

Jig to Safely Hold the Spacers for Drilling

See Chapter 19, p. 170.

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7 – Rear axle. Once again, assuming the body of the hippo is $1\frac{1}{4}$ " thick (if thicker or thinner adjust the following accordingly), cut a piece of $\frac{3}{8}$ " diameter axle $3\frac{1}{2}$ " long. Put glue into the $\frac{3}{8}$ " center hole of one of the rear wheels and insert the axle through this hole until it is flush with the outside. Wipe off any excess glue from the outside of the wheel and let the glue set.

8 – Dry assemble rear axle. Put one of the $\frac{3}{4}$ " diameter spacers onto the rear axle up against the wheel that has been glued to the axle. Insert the axle with wheel and spacer into the hole in the rear of the hippo's body.

Place the second $\frac{3}{4}$ " diameter spacer onto the axle that has extended through the body of the hippo, then put the second rear wheel onto the axle.

Adjust the position of the second wheel such that there is about $\frac{1}{32}$ " space between each spacer and the body of the hippo. Place a mark where the axle is flush with the outside of the second wheel.

Remove the second wheel and trim the axle at the mark. Set aside these two rear wheels, one with the axle attached. Finish will be applied to them before final assembly.

Head

1 – Sides. Using the template in Figure 15-6, transfer the outline of the head sides onto each of the two $\frac{1}{4}$ " thick blanks with the grain running lengthwise. Mark the location of the axle peg eye which is also the pivot hole.

2 – Drill and shape. Drill the eye/pivot hole through each blank using a $\frac{1}{4}$ " drill bit. Cut out the two sides for the head within $\frac{1}{16}$ " of the outline, but do not sand them to the outline just yet. The distance from the eye/pivot hole to the bottom of the jaw is critical to the proper opening of the mouth, so be careful in drilling and cutting out these pieces.

3 – Spacer assembly. The head is formed from the two spacer pieces and the two head sides. Cut the end of the upper head spacer at a 45-degree angle as shown in Figure 15-4a. Glue the lower head spacer to the other end of the upper head spacer as shown in Figure 15-4a. This will be referred to as the "spacer assembly." Allow the glue to dry before continuing to the next step.

4 – Head construction. The spacer assembly has one squared off end which will become the nose and one end cut at a 45-degree angle. After the sides are glued to the spacer assembly, it will be shaped to conform to the shape of the

sides. For now, leave the spacer assembly squared off at the nose end.

5 – Teeth. To drill the holes for the teeth, place the spacer assembly upside down on a piece of scrap wood. Drill a $\frac{3}{8}$ " hole in a piece of scrap wood to determine if the $\frac{3}{8}$ " pieces of dowel being used for the teeth will make a good glue joint in a $\frac{3}{8}$ " hole. If not, adjust accordingly. Drill the holes for the teeth under the nose of the head in the locations shown in Figure 15-4b, then glue the teeth in place.

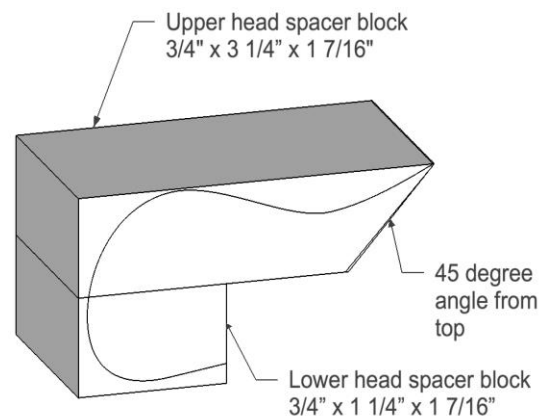


Figure 15-4a. Spacer Assembly

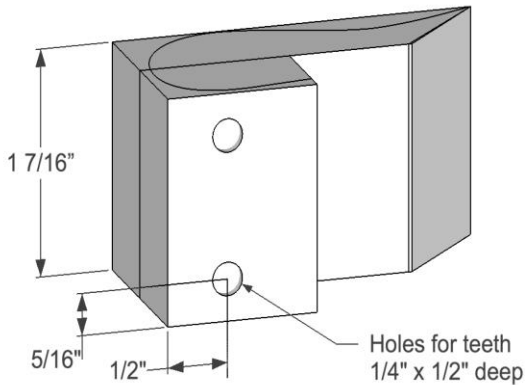


Figure 15-4b.

6 – Glue spacer assembly to head sides.

Begin by assembling but **not gluing** the front and rear wheels onto the body of the hippo. Adjust the front wheels so that the drive pegs are at the top of the wheel and opposite each other.

Next secure the hippo's body to your workbench with a clamp or vice, keeping the wheels in the position described above. Use an axle peg to dry assemble (assemble without glue) one of the head side pieces to one side of the hippo's body, inserting a 1/4" washer between the side and the body. Allow this side piece to rest on the drive peg on that side. Repeat with the other head side piece and other side of the hippo.

Next apply glue to the sides of the spacer assembly and place it between the two head sides as shown in Figure 15-2. Be certain to orient the spacer assembly such that the squared off double thickness is at the nose end and the cut-off 45-degree angle is at the roof of the mouth. Press this assembly together, making sure the head side pieces are within the edges of the spacer assembly and are lined up exactly opposite each other. Any excess of the spacer assembly will be removed later. Now clamp the head sides to the spacer assembly. The newly formed "head assembly" should rotate freely on the axle pegs. Allow the glue to dry completely.

7 – Shape. Once the glue that created the "head assembly" is dry, remove the axle pegs and the head assembly from the body of the hippo. Cut and then sand the squared off end of the spacer assembly now attached to head sides, so it matches the shape of the head side pieces. Sand the head assembly to the outline drawn on the two head sides.

Next, sand the edges to a generous radius. Then sand all surfaces and edges up to 150 grit sandpaper. Be careful around the lower end of the jaw. Do not remove too much wood in order not to reduce the amount of open/close action of the mouth.

Finish

1 – Sand. All surfaces should be sanded with 150 grit sand paper. If the wheels have been made, sand a slight round over on the edges to remove any rough spots.

2 – Seal coat. Apply de-waxed shellac to all surfaces except the wheel axles and tenons of the head pivot axle pegs. Lightly sand after the shellac dries, then remove any dust.

3 – Paint eyes and teeth. The heads of the head pivot axle pegs that are the hippo's eyes. Put painter's tape on the tenons of the axle pegs to protect them from paint, then paint the heads a dark color (say blue or black). Paint the teeth white.

4 – Top coat. Apply water-based polyurethane to all surfaces except the wheel axles and axle peg tenons. Once dry, lightly sand again if applying a second coat of polyurethane.

Assemble

1 – Ream out holes. If finish has gotten into the axle peg eye pivot hole or the axle holes, it might be necessary to ream out these holes before assembling the hippo.

Reaming out Holes

See Chapter 19, p. 169.

2 – Rear wheels. Place one of the $\frac{3}{4}$ " diameter spacers onto the rear wheel glued to the rear axle, then insert this axle through the rear of the hippo. Place the other $\frac{3}{4}$ " diameter spacer on the axle protruding out the other side of the body. Next place glue into the center hole of the second wheel from the side that will be on the inside and insert this wheel onto the axle such that the axle is flush with the outside surface of the wheel. Wipe off the excess glue.

Warning

For each of the instructions that involve gluing a dowel into a hole, be certain to get a good glue joint. For instructions to check the glue joint, see Chapter 2, p. 19.

3 – Dry assemble front wheels. The positioning of the front wheels is critical. The drive pegs on the two front wheels are located towards the body and at 180 degrees from each other to assure proper movement of the head and mouth.

It is suggested that the front wheels be assembled dry to test the movement of the head and mouth in the next step.

4 – Attach head and mouth. Place the head assembly onto the body. When doing this it is necessary to slip a washer between the body and the side of the head before inserting the axle peg. This is done on each side. With the front wheels in position (step 3), test that the drive pins are set to cause the mouth to move up and down as the front wheels turn. Once satisfied with the movement of the head, remove the axle pegs and head assembly.

Put a small amount of glue into each side of the $\frac{15}{64}$ " holes in the head using a nail or tooth pick. Lightly coat the inside of the hole, then wipe off any glue on the outside surface. Next place the head on the body, slip the washers between the body and the side of the head, and insert the axle pegs into the holes. Move the head up and down to be certain there is no glue stuck to it.

5 – Attach front wheels. Insert the front axle with one wheel already glued to it into the hole in the front of the hippo. On the wheel not yet glued to the front axle, put glue into the center hole from the inside of the wheel, then put this wheel onto the axle so that it is flush with the outside face.

Be certain to align this wheel so that its drive peg is at 180 degrees to the opposite front wheel drive peg. Wipe the excess glue off the outside of the wheel that was just glued. Let the glue set.

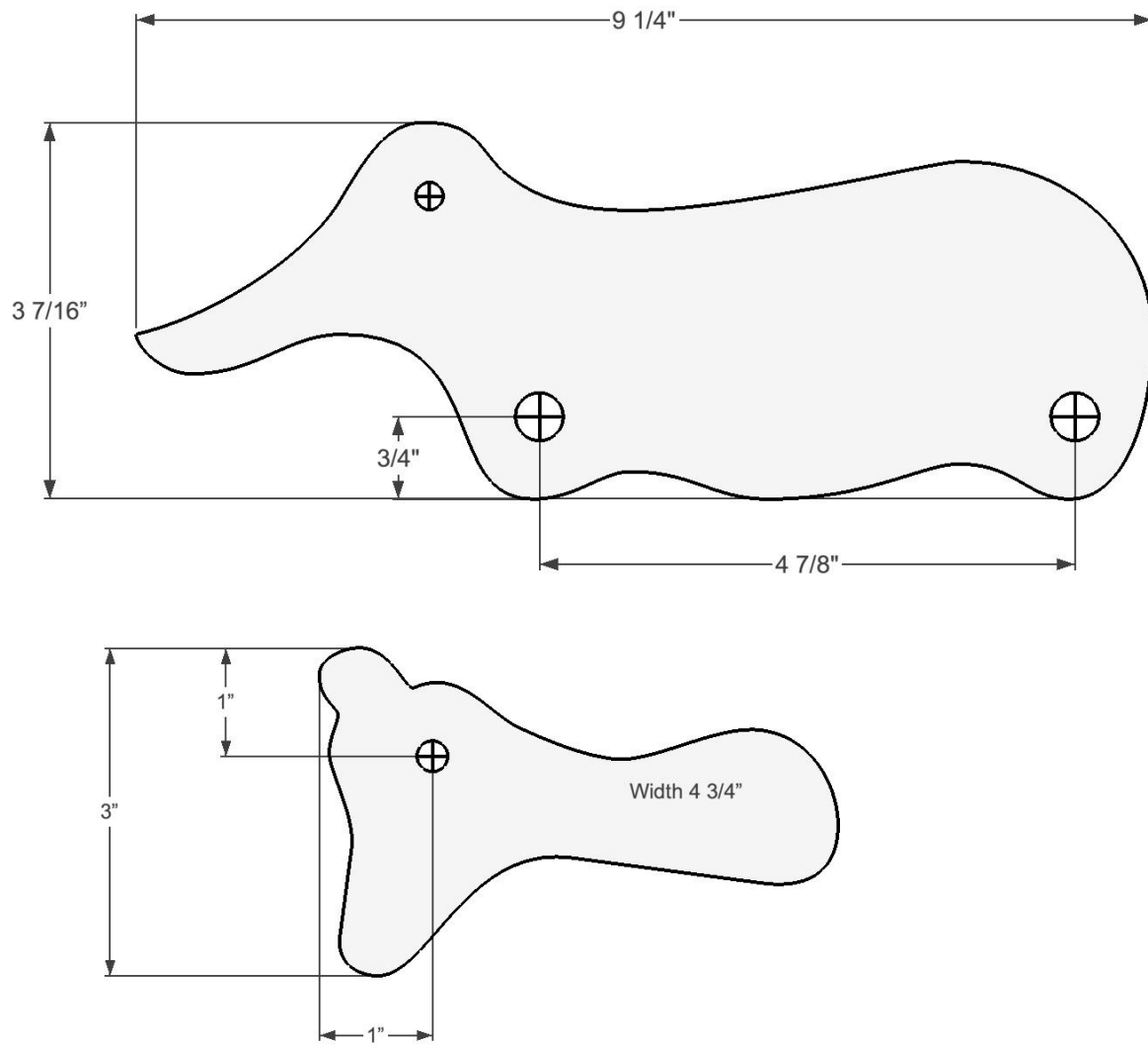


Figure 15-5. Dimensions

Figure 15-6. Templates (next page)

