Building Nest Boxes and Nest Box Kits as a Group Activity

From Individual Boxes to Mass Production of Kits

Charles G. Wade and SCVAS Volunteers
January 20, 2007

Table of Contents

Introduction

Building nest boxes for birds is a wonderful activity which serves to educate the public about wildlife and to build camaraderie in groups. It is an especially useful method to educate children about environmental problems.

A practical barrier to building nest boxes is that of just getting started: locating plans, tools, materials, and, hopefully, an experienced helper or two. An alternative is to buy a nest box kit which is ready to assemble. This article is written to provide assistance in two areas:

1. It provides plans and instructions for making and assembling one or a few nest boxes with a simple design. Such information is available from many sources, and references are provided for more extensive information.
2. It provides information on methods with which volunteers can mass produce nest box kits ready for assembly. This information is rather unique and probably not available elsewhere. Having these kits readily available increases the number of boxes which could be assembled, for example, by school children

The article is tempered with experience and tips derived from the experiences of volunteers in making and helping assemble nearly 1000 nest box kits in Silicon Valley over the past decade.

Scope of Article

This article describes the activity of nest box building by a group of volunteers in the Santa Clara Valley Audubon Society. The initial portion of this article provides information on building nest boxes from a simple design which is assembled using glue and screws. Information on dimensions, wood sources, basic tools and methods is given.

The second portion of the article discusses methods for mass production of nest box kits. When complete, these kits are ready to assemble: precut with screw pilot holes and the entry hole all in place. Tools and techniques for the mass production of kits by groups of volunteers using common woodshop power tools are described. Detailed step-by-step plans for assembly are given together with

helpful hints for assembling nest boxes with children. Internet sites and references are provided.

Safety First

All woodworking tools are inherently dangerous. Improper use of the tools can result in injury. Read, understand and follow all the safety instructions with the tools you use. It is especially important that all involved in building and assembling the nest boxes wear safety glasses or safety goggles.

Acknowledgements

Many volunteers have contributed to the success of this program. Thanks go to Andrew Kellock, Philip Rice, Lee Pauser, Jim Mason, Milt Schmidt, Pat Pizzo, Gus Constant, Arnold Moore, Cheryl Turner, Steve Joesten and Kevin Murphy all of whom have spent many hours on this project. Lee Pauser in addition contributed valuable and critical editing skills. Dave Altknecht did a superb job on the nest box graphics. The IBM Almaden Research Center deserves thanks for encouraging community involvement and aiding this project. The author wishes to make a special acknowledgement to Prof. T. E. Musselman of Quincy (IL) College (now University) who championed bluebird box trails and provided plans more than 60 years ago.

Building Nest Boxes From a Simple Design

Nest Box Design

The style used for these nest boxes is shown in Figure 1a and 1b. The dimensions will change to suit the species (Table 1). Our approach is to assemble these boxes with (exterior) glue and screws, though nails can be substituted for the screws. If screws are used, the outer pieces are usually predrilled, and usually with a bit that allows countersinking of the screws.

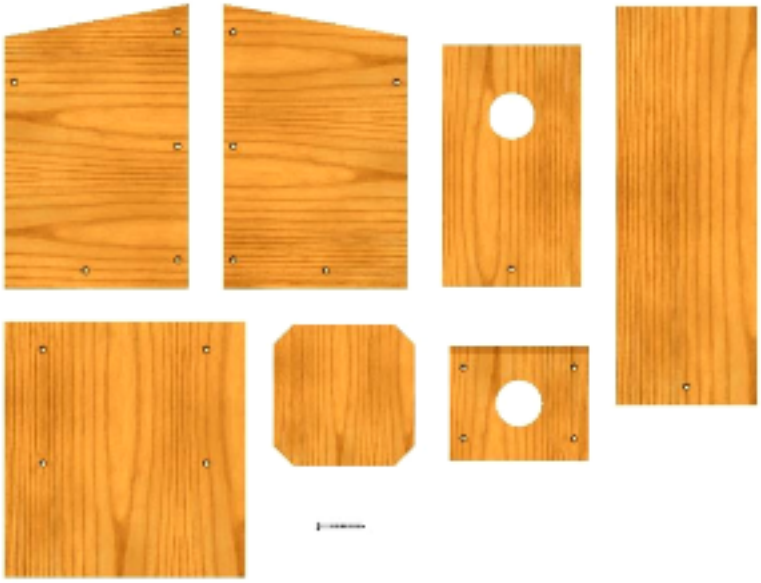
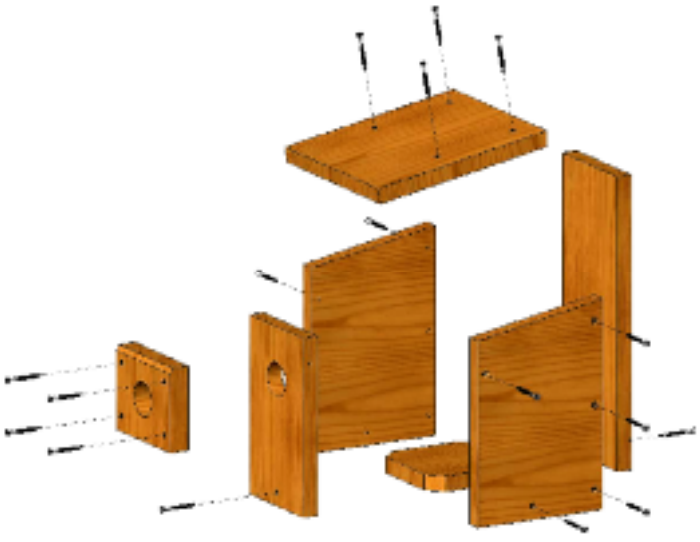


Figure 1a. Nest box and its parts

This design allows the front to be raised upwards if the lower front screw is removed. The predator guard (smaller block with an entrance hole) is an option. It may be added if raccoons or cats are a problem (see the section titled *Variations in the Front of the Nest Box*).



The upper end (short dimension) of the roof for all nest boxes should be cut (beveled) to fit snugly against the back. For the dimensions given in Table 1, the bevel is 10 degrees.

The front opens upward (from the bottom) for monitoring and cleaning upon the turning of the L screw (or the removal of the screw in the box of Figure 1a). Upper screws on the sides serve as hinges (not shown). The front is cut narrower than the bottom and the back to reduce friction on opening for monitoring. The top of the front has a ½" clearance space under the roof for air circulation.

Figure 1b. In this style, the only change is that the front is modified to allow closure with an L-shaped screw. This simplifies inspection and is often used on trails where viewings are frequent (see the section titled *Variations in the Front of the nest Box*).

Nest Box Dimensions

Table 1 lists representative dimensions for nest boxes with the general structure shown in Figure1b. There are many sources of these and other nest box plans[1, 2] (also see the section titled *Nest Box Information Online*). If you search the sources you'll find some minor disagreement in dimensions such as entrance hole sizes, height for mounting, etc. Some of these may be regional variations, such as the fact that Western bluebirds are somewhat larger than Eastern bluebirds, hence the hole size differences in the table. In general, the larger the bird the larger the nest box, but small birds are quite capable of filling large boxes. Other variations reflect that no one is absolutely certain what sizes are the best, but those shown seem to work.

Don't be a slave to precisely reproducing the dimensions written below. Keep in mind that these birds flourished long before man started building dimensionally defined nest boxes; they were

adaptable then to all sorts of living conditions and are still adaptable today. Thus small changes in the dimensions are not crucial.

However, it is important to pay attention to the diameter of the entrance hole. In general these should be just large enough to admit the bird you want to attract; anything larger may let in larger birds, which may be predators or space competitors. Thus you shouldn't make *major* changes in the diameters of the hole.

The dimensions given are in inches and assume ¾" thick stock material. Those listed are for the box designs in Figure 1a and 1b which are designed to be mounted by attaching to a pole, tree, post or building.

Table 1

Species	Bottom (interior)	Back (W x H)	Front[1] (W x H)	Roof[2] (W x L)	Sides[3] (W x H)
Chickadee, Nuthatch, Oak Titmouse	4 x 4	4 x 13	3-7/8 x 8½	7½ x 8	5½ x (9, 10)
Tree Swallow, Violet-green Swallow	5 x 5	5 x 14	4-7/8 x 8½	8½ x 9	6½ x (9, 10)
Western Bluebird	5 x 5	5 x 14	4-7/8 x 8½	8½ x 9	6½ x (9, 10)
Bewicks Wren, Eastern Bluebird, House Wren	4 x 4	4 x 13	3-7/8 x 8½	7½ x 8	5½ x (9, 10)
Wood Duck	10 x 18	10 x 36	9-7/8 x 26	13½ x 20	19½ x (27, 33)

Notes:

1. The width of the front is cut 1/8" narrower than the bottom and back to reduce friction when opening and closing the box. The length is designed to leave a gap for air circulation under the roof.
2. The roof has a 10 degree bevel cut to fit snugly against the back (Figure 1b). The dimensions of the roof are not critical, except that an adequate overhang should be provided to ward off predators and to provide a dry, cool interior.
3. If the wood thickness differs from ¾", the only dimension that needs to be adjusted in these plans is the width of the sides. The two dimensions inside parentheses indicate the front and back heights of the sides.

Entrance Hole Size and Box Mounting Height

Table 2

Species	Entrance Hole Size	Entrance Hole Location (inches from bottom of front)	Box Mounting Height (feet above ground)
Chickadee, Nuthatch, Oak Titmouse	1-1/4" in diameter	6	6-15
Tree Swallow, Violet-green Swallow	1-1/2" in diameter	6	10-15
Eastern Bluebird	1-1/2" in diameter	6	5-10
Western Bluebird	1-5/8" in diameter	6	5-10
Bewicks Wren	1-1/4" in diameter	6	6-10
Wood Duck	Oval shape, 3" high x 4" wide	20	10-20
House Wren	1" in diameter	6	6-10

No Perch

No perch is used on these boxes. The birds which use these nest boxes don't need them for entrance, and larger, predator birds could use them to more easily attack the nest. Thus, we don't use them.

To Paint or not to Paint

Painting with an appropriate paint can lengthen the life of a nest box but the impact on the birds is sometimes uncertain. The vision of birds differs from that of humans. They have a 4 cone visual system as opposed to the 3 cone system in humans, so their visual interpretation of color is probably not directly transferable to the human experience. They can, however, distinguish colors, and they can also see ultraviolet light. That being true, colors that fit into the environment (earth tones) are probably best to use for the boxes. White is not a common color in the environment, so probably it should not be used. Dark colors will of course make the box warmer, and many experts argue the resultant heat is detrimental to the young birds. They recommend lighter colors (light tan or gray) so the box is cooler. If

you do paint, coat only the outside and use latex paint. Let the paint dry for a few days until all the odor is gone before putting it up for use. Many people prefer leaving the wood in the natural state. Children especially like drawing on and personally decorating their boxes. For some, it's more exciting than building the boxes. Consequently, in our sessions we offer them a choice of colored permanent ink pens for drawing.

Materials and Tools for Building Nest Boxes and Nest Box Kits

Wood with a thickness of ¾" is ideal for assembly. While material as thin as 3/8" can be used, it requires greater precision in aligning the screws. Material 1" or more in thickness is suitable, but it makes for a heavier nest box. If the wood you use differs in thickness from the ¾" thick stock used in Table 1, it is not a major consequence, but you may want to modify the width of the sides,

Cost may be a factor if you buy the wood but keep in mind that some types, such as cedar, cypress, redwood and (exterior) plywood are weather resistant and therefore will last longer. Avoid wood treated with preservatives. Plywood is especially useful because it usually is available in large flat sheets and, with care, you can plan your cuts to minimize the waste.

To ensure that you have exterior plywood (made with waterproof glue) look for the word "exterior" on the piece or the letter X in a three letter code on the wood. For example, plywood labeled ADX is A (the best) grade on one side, D (a poorer grade, lots of knots and repairs) on the other, and X (approved for exterior use). CDX is quite suitable for nest boxes, and exterior building siding is especially good. A 4' x 8' sheet of plywood will yield about 9 chickadee nest boxes (Table 1) and a proportionately smaller number of larger boxes.

Another factor to consider is where the box will be located. If it is located in an area frequented by woodpeckers, it may be subjected to damage as the woodpeckers often enlarge the hole or bore a new one. In such an environment, a box made of plywood is more appropriate than one made of redwood, which is much softer. A predator block (Figure 1a) made of a thin piece of hard plastic or metal placed on the front of the box will serve as a deterrent.

Wood Sources

Lumber yards, home improvement centers, hardware stores and building salvage companies are sources. You may be able to get a very reasonable rate if they know you are working for a charitable activity. If you buy redwood, you can help the environment by ensuring that it is harvested from re-growth redwood, not from old growth forests. You can often obtain plywood, home siding and other woods from construction sites for free since they regularly dispose of the scrap pile every few days. These materials lend themselves nicely to nest box parts because they are usually flat (no warp). Be certain to ask permission at the construction site for this source.

Using salvaged lumber has the additional advantage that it diverts the wood from landfill disposal. Salvaged fencing, especially cedar or redwood, can also be used but experience dictates that because of defects (rotted sections, nailed areas, knotholes, warped sections and splits) usually only about 30-40% of the wood can be used. Consequently, you are left with a disposal problem of the remainder. Salvaged fencing is very susceptible to splitting, so it is essential that parts from this material be predrilled with screw pilot holes.

Tool Requirements

For making a few boxes, the following list of tools and materials is usually sufficient:

- Safety goggles or glasses
- Hand saw (or electric circular saw) for cutting the wood
- Hand drill, battery powered portable drill/driver or drill press for drilling holes
- Screwdriver or a battery powered portable drill/driver (as above) for inserting screws
- Hole cutter drill bit suitable for drilling the appropriate entrance hole
- Drill bits to drill the access holes for screws in the top, front, back, and sides. Bit assemblies which include a countersink are useful as the screw heads can then be set below the surface.
- Screws: #6 Phillips head screws about 1-5/8 ” long work for the material in Table 1. The front pivot screws can be the same length, but if the interior will be frequently accessed, a stronger pivot will result if screws 2” long are used. Drywall screws are inexpensive and work nicely but do tend to rust and stain the

box over time. If you care about long term cosmetics, use screws designed for exterior use, such as deck screws.

- Waterproof (exterior) carpenter's glue is preferred. Glue provides long term stability for the nest box. The yellow version is non-toxic and water soluble. It dries much more quickly than white glue. Examples are weatherproof *Titebond II* and *Titebond III*.
- A small square (adjustable tri-square is preferable), measuring tape, and marking pencils.

Instructions for building the boxes are in the section titled **Assembly of Nest Box Kits**.

Mass Production of Nest Box Kits

Note: this section assumes some familiarity with power tools. Remember to wear safety glasses or goggles at all time. Review the safety instructions for the tools used.

Over the past decade, within a focus of the SCVAS, our expanding group of volunteers has made nearly 1000 nest box kits using "mass production" methods. The kits, in the simple design of Figure 1, are cut and predrilled with all holes. They can be assembled easily with glue and wood screws.

Having a supply of kits makes it much easier for school groups, scouts, and similar organizations to build the boxes. In addition the volunteer group often assembles boxes, especially bluebird and chickadee boxes, and stores these at SCVAS for use on birding trails. Each year, this group prepares 100 to 150 kits and often assembles half of these.

A group effort is essential to this operation because making the kits is very time intensive. Our experience is that even with mass production methods, if you divide the number of volunteer hours involved (cutting, drilling, sorting) by the number of kits produced, the result is nearly 45 minutes of volunteer time per kit. This does *not* include the time needed to obtain and salvage the wood.

While a few of the volunteers in our group have strong woodworking skills (and workshop tools commensurate with the project), the majority have little direct experience, but they learn to operate some tools, such as the drill press, and become very proficient at assembling the kits. Over the years of these activities, we have developed specialized procedures and useful jigs which simplify the production of large numbers of reproducible parts.

The most efficient method of cutting parts for large numbers of kits is to use power tools set up in such a fashion that all the parts are cut sufficiently accurately that they are interchangeable. Measurements are usually done only on one part, and then jigs or stops are used on the tools so that accurate cutting is done merely by placing the wood against the alignment jigs or stops. Whenever using stops, you should ensure that their placement doesn't permit the buildup of sawdust and chips which might prevent the wood from setting against the stop, thus affecting the length of the cut. Most of these methods will be familiar to experienced woodworkers who often use jigs to make identical parts. This section talks about techniques which have been used to good effect in recent years.

Tool Requirements for Making Kits

A standard collection of workshop tools, those used by almost all who pursue woodworking for a hobby can be used. The basic power tool requirements, used in conjunction with the tool requirements listed previously, are:

1. A table (or a cabinet) saw used to rip the wood into strips of the proper width.
2. A miter (or a chop) saw or a radial arm saw used to cut the strips to length (and to proper angle).
3. A drill press used to make the entrance hole in the front and the screw access holes.

The Process

For a mass production session, first decide on the number of nest boxes you want to make, then ensure by rough measurements that you have a sufficient amount of wood to do this. As noted earlier, nine chickadee nest boxes can be cut from a standard 4' x 8' sheet of plywood. Most salvaged wood, however, is irregularly cut and does not come in such convenient full dimensions.

It helps to stack the wood into three approximately equal piles: one pile will provide the sides, one will provide the tops, and one will provide backs, fronts and bottoms. This will overestimate the amount for the tops somewhat, but the number of parts can be fine tuned as the process evolves.

The first step is to use the table saw to rip the wood into strips of the proper width for fronts, for backs/bottoms, for sides, and for tops. For the chickadee box in Table 1, for example, this means strips 3-7/8", 4", 5-½ " and 7-½ " wide. As the cutting proceeds, a measurement of the total length of the strips can ensure balance in the requisite number of component parts for complete sets.

Ripping parts to the desired width on a table saw is the first step.

A radial arm saw is used to cut the strips into pieces of the proper length. One person feeds the strips from the right against a stop, and the other operates the saw and removes the piece.

Second, the appropriate parts are cut to length with the miter saw or radial arm saw. This is done with a simple stop clamped to the saw so the lengths of each component are the same. This second step is done with all right angle cuts, so that the parts at this stage are squares or rectangles.

Cutting the roof slope angle on the sides is done with either the miter saw or the table saw. With the former, the blade can be rotated to the proper angle to the fence with a stop block used to define the length. Alternatively, the blade can be left at a right angle to the fence and jigs are clamped in place to hold the side at the proper angle and length for a successful cut. Angle cuts on the table saw can also be done. Set the miter accessory set to the proper angle and clamp a block to define the proper length.

A miter (or chop) saw can cut the angles for the sides, trim the corners of the bottoms, and cut the bevels on the roof pieces.

If the sides have two different surfaces, such as often happens with siding where one side is to face the exterior, it is important to orient the pieces so the desired surfaces face outside for *pairs* of the sides. Often this means handling and moving them in pairs with the exterior sides facing out. In most of our sessions we tape each pair to hold them together (see the section titled **Drilling Holes**). They can still be cut and drilled if the tape is around the waist of the pair. This ensures that the correct sides face outward and that all holes match. When cutting roof bevels, ensure that the proper side faces upwards for assembly.

The bottoms have the corners clipped to ensure air flow and drainage (Figure 1a). This can be done on a miter saw with the blade set to 45 degrees, but be careful to use clamps, not your fingers, to hold the pieces as the distance to the blade is short. Such cuts can be done efficiently on the table saw with the following method. (Caution: this can be a very dangerous operation, so care and skill are required). Clamp a stack of about 15 bottoms so they resemble a loaf of bread. The clamp must be very secure and situated such that it can't be hit by the blade. The process is to send the stack through with the blade set at 45 ^{0}. A zero clearance table saw insert, adapted for the blade tilt angle should be in place[3]. If a right tilting saw is used, an auxiliary fence is clamped to the *left* of the blade with the proper distance such that the corners are clipped and the chips slide away from the blade. If this process feels unsafe, you can drill four to six

3/8" diameter holes through the bottom for air circulation, and use it without clipping the corners.

Roof pieces can be cut on any of the power saws. The blade should be rotated to a 10 degree angle and a stop block used to define the length. The 10 degree bevel cut can be done on each end, so sequential cuts are fine.

Drilling Holes

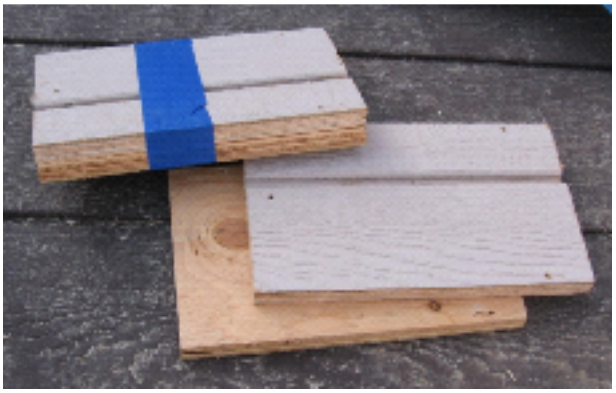
One method of drilling the holes is to make templates and use these with battery powered hand drills. The templates are made by measuring and marking up components of the kits for the holes, and then drilling. Identify the template by marking it in some fashion, such as with a colored pen, so it won't be mistaken for a kit. The template method works nicely if you have a sufficient number of drills available. In fact, it is about the best method to use for drilling the holes in the roof. Take care to ensure that the holes are properly located in the template, and that the template is carefully aligned on each successive part. A simple jig can often help with the latter.

A drill press can also be used to drill all holes. It is very efficient if the fence is adjusted to in terms of the desired distance between the holes and the edge of the piece. Clamped blocks can be used to define the location of the holes once the edge distance is established. It is useful to visualize the drilling as a several step process (Figure 3). Drilling the entry hole is the first step. The hole should be centered in the front, and the distance from the drill bit to the top of the front (against the fence) is adjusted as per Table 1.A block (or sometimes two) clamped parallel to the front serves to both center the piece and to reduce the tendency to rotate. A hole cutter with 3 cutting arms is preferable to other styles, including cylindrical cutters, because it is easier to remove the cut out portion. Spade and Forstner bits can also be used, but for holes this size they require a

A drill press is an essential component of the mass production method.

powerful drill press, and they also create a large amount of shavings. It is wise to work on the fronts early in a session since they take longer than many of the other steps.
Drilling the pilot holes for the screws used in attaching the sides and bottom requires two separate drill press processes wherein the edge of the piece is pressed against the drill press fence. The grouping of the holes defines these: one with the bit 3/8" from the edge, and one with the bit ½" from the edge (Figure 3). Pilot holes are drilled only through the outer piece of wood, through the sides for example but not into the back. This can be done with any wood boring bit, but using a countersink bit will let the screws seat below surface.

Taping pairs of sides together with masking tape is a useful method It speeds the process since you are drilling two pieces at once and also ensures that you maintain the correct symmetry if there is an exterior side of the material.



Taping the sides in pairs speeds drilling and ensures outer/inner symmetry of sides.

For most of the pilot holes, the only critical is the distance from the edge. An exception relates to the two holes which form the pivot for the front, since they must be placed so they occur at the same geometric position on both pieces (Figure 3b). This equivalence can be obtained by using a stop block on the press to ensure the placing. Use a spacing of ½" between the bit and the fence to drill the bottom holes. This permits the bottom piece to be offset into the cavity about 1/8" (see the section titled **Assembly of Nest Box Kits**).

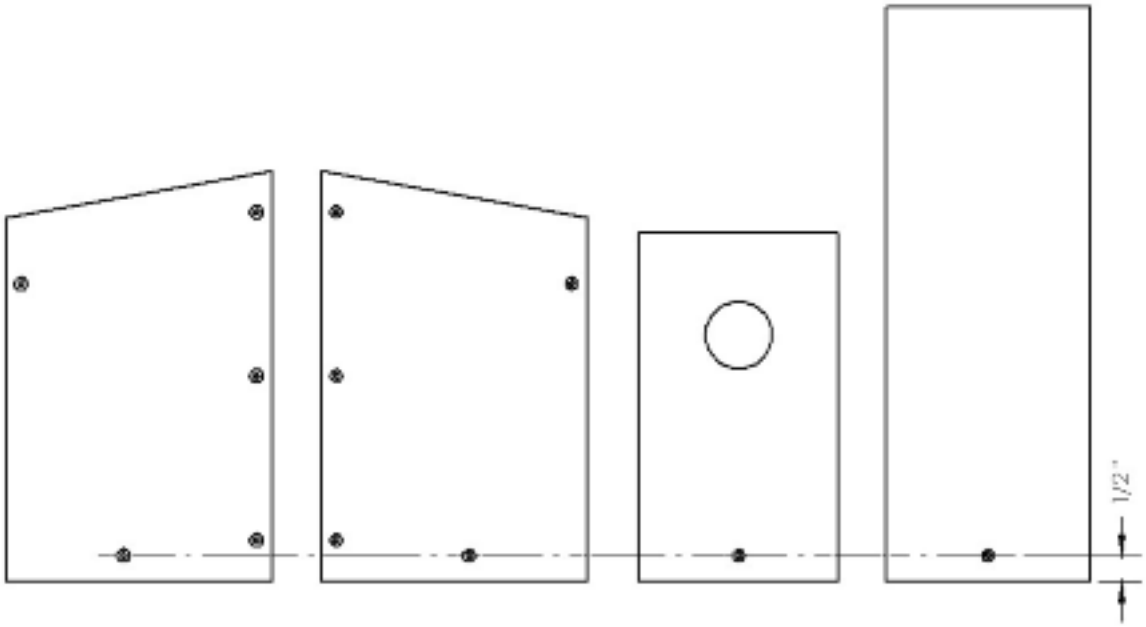


Figure 3a. All screw holes which involve the bottom piece are ½" from the edge and can be done with one fence setting of the drill press. This spacing allows the bottom piece to be recessed 1/8" or so during assembly.

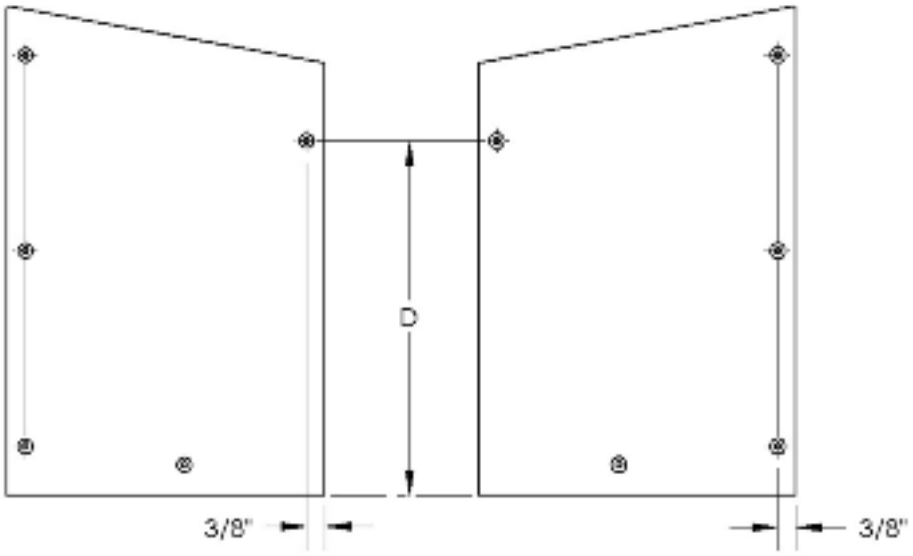


Figure 3b. The holes in the vertical part of the carcass are all 3/8" from the edge and can be drilled with one fence setting on a drill press. Aside from the distance from the edge, the only critical dimension is that D for location of the screw pivot. These must be in the equivalent spot in both sides, located about at the top of the entry hole (approximately 6.5" on nuthatch boxes, Table 1, and scaled appropriately for others).

Clamped stops held define equivalent pivot holes on the drill press.

Regardless of the method used, whenever you are making several kits it is wise to assemble a complete box before you are too far into the process so that you can correct any errors in your setups.

An Example

A typical building session of our group, with perhaps10 volunteers, would use a table saw, a radial saw, a miter (or chop) saw, three drill presses, and several drill/drivers. Two experienced woodworker volunteers are assigned to the table saw. They survey the lumber and sort it into stacks for the most efficient cutting of the parts. As they progress cutting strips, they keep track of the approximate lengths needed for the number of nest boxes desired.

Two other experienced woodworker volunteers work to first cut the strips to length on the radial saw and then to cut the slope on the sides with the miter saw. They or the table saw group cut the bevels on the tops.

Three volunteers staff the drill presses. One of the presses is set to cut the entrance hole, one is set to drill the screw pilots which are 3/8” from the edge, and the third is set to drill the pilots that hold the bottom (½ ” from the edge).

The remaining volunteers use templates to drill the holes in the roof, and then begin assembling nest boxes (see the next section). As the cutters and drillers finish their components, they also begin assembling. This process does require some flexibility as the cutting or the drilling might lag depending on circumstances, but with experience it works quite smoothly.

Sawing is sufficiently dangerous that it should be done only by experienced woodworkers. All of the other steps, however, including drilling and assembling, can with some initial training be done by people with little experience, so the activity can accommodate all types.

In three hours, a group of 10 (including about 4 with experience with power saws) can make 80 kits and assemble 40 of them.

Assembly of Nest Box Kits

This section describes the assembly of the kits and also offers tips on assembling kits with children. In addition to the kit you'll definitely need the following:

- ✓ Safety goggles or glasses
- ✓ Waterproof (exterior) glue. Yellow woodworkers or carpenter's glue is preferred. Glue provides long term stability for the nest box. The yellow version is non-toxic and water soluble. It dries much more quickly than white glue. Examples are weatherproof *Titebond II* and *Titebond III*.
- ✓ Glue brushes and small bottles (plastic) to hold the glue. We use cheap metal flux brushes available at any hardware store. At the end of the session, all can be saved for reuse by washing with soap and water before the glue sets.
- ✓ Screws: #6 Phillips head screws about 1 5/8 inches long work for the material in Table 1. These same screws can also be used for the pivot. However, it the boxes will be opened frequently, it is wise to use 2" screws since the pivot will be stronger. Drywall screws are inexpensive and work nicely but do tend to rust and stain the box over time. If you care about long term cosmetics, use screws designed for exterior use, such as deck screws. 16 screws are needed, 20 if you use a predator guard.

- ✓ Screwdrivers or battery powered portable drill/drivers for driving the screws
- ✓ Paper towels
- ✓ If you intend to mark or personalize the boxes, bring some permanent ink markers of different colors. These will fade over several months in the weather, but they offer short term excitement for children.

To be prepared for the inevitable problems, it helps to have available the following, just in case:

- ✓ Drill bits to re-drill the access holes for screws
- ✓ Handsaw for correction cuts of parts
- ✓ A small square, measuring tape, and marking pencils
- ✓ A few extra kits and screws
- ✓ Re-chargers for the drill/drivers plus an extension cord
- ✓ Some rubbing alcohol and tweezers for splinter removal

Tips for Working with Children

In our sessions, an initial discussion of safety is always done, and the children and adults are given safety glasses. Usually these are a source of excitement and discussion. The only tools used in assembly are battery powered drills with Phillips bits. Like all power tools, these are safe if used as instructed.

Children should realize that the drills are not toys and that tools should not be randomly trifled with. The adults should monitor the children closely during the assembly session.

Glue is applied using a small brush, about half an inch wide. This method uses less glue than squeezing glue directly from the bottle, an advantage that is especially important if children are involved in the assembly. The glue provides long term binding while the screws provide the initial holding strength.

Screws are driven into the wood with either hand screw drivers (hard for the long term) or common battery powered drill/drivers. For children (and for many assisting parents), it helps to have some initial discussion about how the drill works especially the relationship between speed and the pull on the trigger.

Children can control the speed of the driver if an adult holds the tool. Note how the child's hand fits at the trigger to control the speed of the drill.

For small children, an adult holds the drill firmly and lets the child pull the trigger. Running the drill is especially enticing for children, and they tend to run it a lot. It's wise to have a command, such as "go", which is given when the parts are in place, the drill is aligned, and all is ready to drive the screw.

If there is time, it helps to put some screws into scrap for practice. In these, one can experiment with removing the screw with the reverse switch, but ensure that the scrap is held firmly in place on the table so it won't rotate. A clamp will help. We've done many sessions with children as young as pre-kindergarten ages; these go smoothly if an adult is involved with each child. Our usual arrangement is four or five adult/child pairs at one table with one experienced adult helping all. The techniques are learned easily.

Children love to decorate nest boxes, so provide multicolored permanent pens.

Assembly Step by Step

It helps to make in advance several assembly jigs such as those in the blue highlight of Figure 4a. These are wooden cubes with the approximate dimensions determined by the width of the back. For chickadee boxes, for example, these are 4" x 4" x 4". In place, they stabilize the sides during installation and are especially useful in children's groups. Alternatively, you can simply use the bottom as an assembly jig as per the assembly drawings.

Begin by first attaching the sides to the back, than continue with the other steps as shown in successive figures.

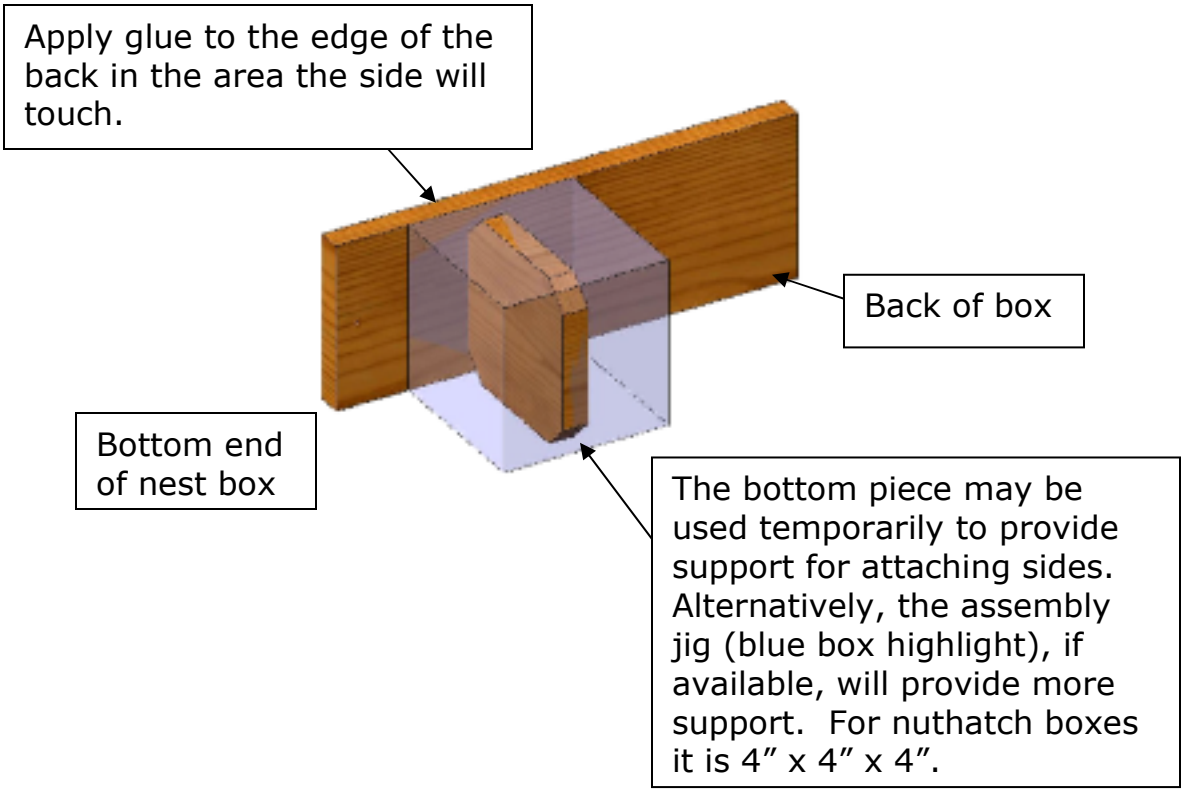
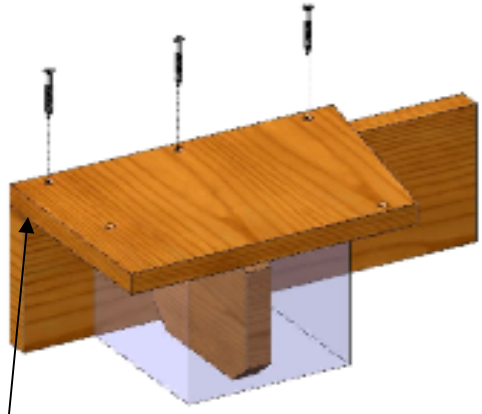
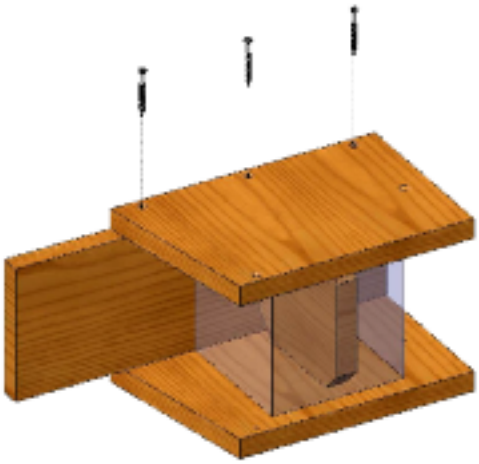


Figure 4a. Beginning assembly



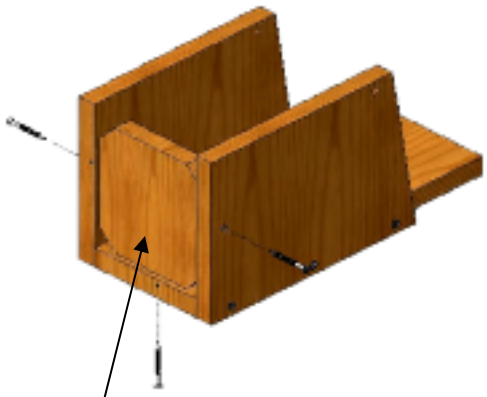
Align parts at bottom, and then drive the screws. With children, an adult ensures the alignment and holds the drill.

Figure 4b. Attaching the first side.



Flip it over, put glue on this side of the back, and attach the other side. The bottom piece (or jig) can be removed after this step.

Figure 4c. Attaching the second side.

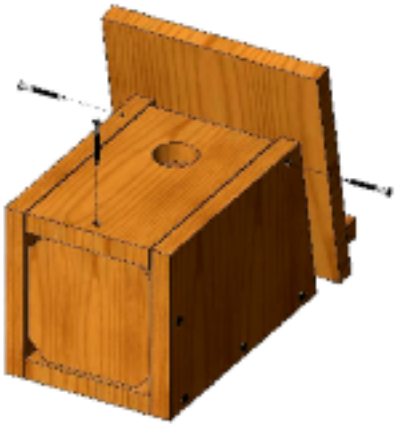


Remove the assembly jig if you have used one. Put glue on 3 sides (only) of the bottom and put it in place (unglued portion towards the front). The bottom should be recessed slightly (1/8") into the box. This ensures that water will drip from the sides to the ground rather than collecting on the bottom causing it to rot. Begin with the screw through the back to pull the piece tightly into place.

Figure 4d. Installing the bottom.

Apply glue to both the tops of the sides and to the area on the back where the top will touch. Be certain the beveled end of the top is pushed tightly against the back. Check that the screw holes are centered over each side, and then attach the top.

Figure 4e. Attaching the top.



No glue is used in this step. To attach the front, align the bottom, center the front in the gap, and put in the bottom screw. Then put in the pivot screws at the top. These should be in the same relative position on each side and loosely tightened (don't pinch in the sides). Adjust the screws until the front is centered between the sides.

Figure 4f. The front is intentionally cut to be a bit narrower than the back and sides. This reduces the friction on opening for inspection or cleanout.

Variations in the Front of the Nest Box

To prevent predators, such as cats or raccoons, from reaching into the box, you can add an entrance block or portal (Figure 5). This piece, which can be 1" or 1 ¾" thick, has an entry hole the same diameter as the bird entry hole and is attached to the front with glue and screws. The length and width of the block are not crucial except the portal should not interfere with raising the front. These are effective because the mammalian predators can't reach around the corner into the box if the entrance is thick.

Similar devices, although thinner and made of plastic or metal, can be used if woodpeckers attempt to enlarge the holes in the boxes.

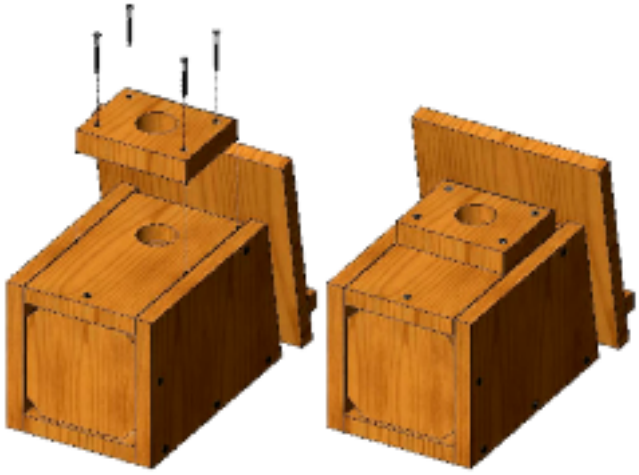


Figure 5. Predator block (portal block) for protection against cats and raccoons.

For boxes that will be monitored regularly, utilizing a front closure such as that in Figure 6 has advantages. This design, though a bit more complicated than a simple screw, has the advantage that it can be easily opened by merely turning the L screw a partial turn. It is especially useful for monitoring nest boxes in which birds are nesting. A pair of pliers or a specially prepared 1" dowel with a groove sawed or carved across the end can be used to turn the L hook. For mass production methods, the grooves can be cut with a dado accessory in the table saw[3]. Stack the front pieces much like a loaf of bread, adjust the fence so the dado cuts at the center of the front approximately ¾" high, and cut the stack.

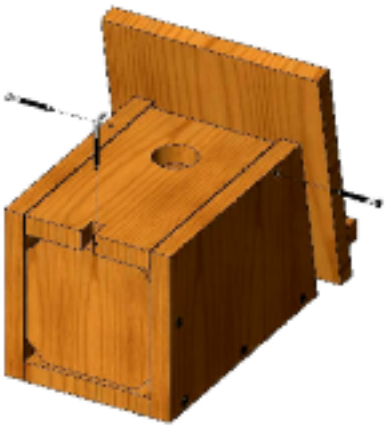


Figure 6. L-screw front closure

How to Enjoy It

Table 2 contains information on mounting information. The section titled ***Nest Box Information Online*** contains a wealth of information on placing your nest box, identifying species, and birding in general. You can also contact the local Audubon society office for information about birds in your region. If possible, get the box mounted in the late fall or during the winter. Early spring is the traditional nest building time for most species. Have fun identifying the birds that use the box.

Nest Box Information Online

http://www.scvas.org/
Web address for Santa Clara Valley Audubon Society in Cupertino, CA. It is the source for information in this region.

http://birding.about.com/
Excellent website on birds and birding, including nest box specifications (dimensions, entrance hole sizes, etc.), free plans on nest boxes for kids to assemble, links to other web sites, a chat room, and a newsletter.

http://www.bygpub.com/bluebird/
Plans for a bluebird nest boxes with good discussions on building these with groups such as scouts. Useful information on practical aspects of assembling nest boxes. The dimensions could easily be altered for other bird species.

http://www.npwrc.usgs.gov/resource/tools/ndblinds/ndblinds.htm
Extensive specifications and discussion about nest boxes for many types of birds. Links to additional information, including where and how to mount the boxes.

http://birds.cornell.edu/
Cornell University site for one of the leading international labs in avian studies. You can become a member of the nest box network which collects and distributes information on nest box monitoring across nation.

http://www.audubon.org/
Online site of the National Audubon Society. An enormous range of information is available and links are given to other sites.

http://www.bsc-eoc.org/regional/barnowlbox.html
Barn owl nest box plans with a further discussion of sitting and mounting.

http://ourworld.compuserve.com/homepages/DTrapp/barnowli.htm
Extensive discussion (worldwide basis) on barn owls, including several barn owl box plans.

Here are some additional sites were you will find nest box plans, some free and some for a price.

http://www.choosefreedom.com/birdhouse.html

http://netsearchamerica.addr.com/Specialty_Search/free_woodworking_plans.htm

http://www.woodtalk.com/resources/plans/freefeeders.htm

http://www.birding.about.com/hobbies/birding/library/blhousespecs.htm

References

1. "Birdhouses. A Step-by-step guide to building attractive homes for your feathered friends". John Kelsey, PRC Publishing 2002, 144 pages, ISBN-13: 978-1-85648-649-1. This book has a focus on hand tools and techniques of building houses. Very nice pictures and illustrations make it useful for beginners. Included are many interesting designs together with a long list of dimensions for various species.

2. "Build Your Own Birdhouses and Feeders", John Perkins, Firefly Books 2002, 144 pp. ISBN 1-55209-135-X This is a fun book with 25 designs, from simple boxes to more complicated structures. The simpler ones are good for building houses with children.

3. "The Table Saw Book" Kelly Mahler, the Taunton Press, Newton, CT 2003, 202 pp. "Table Saw Magic", Jim Tolpin, Popular Woodworking Books, Cincinnati, OH. 1999. 192 pp.