



AAW
EDUCATION

AAW | AMERICAN ASSOCIATION
OF WOODTURNERS
Turning to the Future

TEACHER'S RESOURCE AND PROJECT GUIDE

Teaching Resources

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Turning to the Future Teachers Resource and Project Guide

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Teaching Resources

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A Note About Safety: An accident at the lathe can happen with blinding suddenness. Respiratory and other problems can build over years. Take precautions when you turn. Safety guidelines are published online at <http://www.woodturner.org/?page=Safety> Following them will help you continue to enjoy woodturning.

INTRODUCTION

Greeting from Phil McDonald, AAW Executive Director

The AAW staff and board are pleased to present you with this complimentary special edition of our Turning to the Future Teaching Resources.

The AAW's Turning to the Future program offers reference materials and project resources designed specifically to aid teachers, schools, instructors, and other educators in developing programs to teach woodturning skills to students ages 10 to 25. In addition to supporting instructors who teach hands-on woodturning classes, the program endeavors to raise awareness about woodturning for students, inspire students to turn and create wood art and craft for the rest of their lives, raise awareness of American Association of Woodturners (AAW) and its educational mission. For more about the Turning to the Future program, visit the AAW website at <http://www.woodturner.org/?page=YoungTurners>.



I would like to extend my sincere appreciation to our members for sharing these valuable teaching materials.

Yours respectfully,

A handwritten signature in black ink, which appears to be "Phil McDonald". The signature is written in a cursive, flowing style.

Phil McDonald

SAFETY

Safety & Introduction to the Lathe

It is of utmost importance to teach through example proper respect for equipment and an attitude of safety. After discussing safety concerns with the group, be sure to reinforce safety principles as you provide individual instruction. It is good practice to start each lesson with a safety reminder.



1. Use a full faceshield
2. Tie back long hair, do not wear gloves, and avoid loose clothing objects that may catch on rotating parts or accessories.
3. Always check the speed of the lathe before turning it on. Use slower speeds for larger diameters or rough pieces, and higher speeds for smaller diameters and pieces that are balanced. Always start a piece at a slower speed until the work pieces is balanced. If the lathe is shaking or vibrating, lower the speed. If the workpiece vibrates, always top the machine to check the reason.
4. Check that all locking devices on the tailstock and tool rest assembly (rest and base) are tight before operating the lathe.
5. Position the tool rest close to work, almost touching the wood. Check tool rest position often and as wood is removed, turn off the lathe and re-position the rest.
6. Rotate your workpiece by hand to make sure it clears the toolrest and bed before turning the lathe "on." Be certain that the workpiece turns freely and is firmly mounted. A handwheel on the outboard side of the headstock simplifies this process of spinning the lathe by hand before turning on the switch.
7. Be aware of the turners call the "red zone" or "firing zone." This is the area directly behind and in front of the workpiece - the areas most likely for a piece to travel as it comes off the lathe. A good safety habit is to stop out of this zone when switching the lathe to the "on" position. When observing others turn stay out of the area.
8. Hold turning tools securely on the toolrest, holding the tool in a controlled and comfortable manner. Always contact the tool rest with the tool before contacting the wood.
9. It is safest to turn the lathe "off" before adjusting the toolrest or tool rest base (banjo).
10. Remove the tool rest before sanding or polishing operations.
11. Never leave the lathe running unattended. Turn the power off. Don't leave that lathe until it comes to a complete stop.

SAFETY



How to Determine Safe Lathe Speeds

Appropriate lathe speed should allow the blanks to be turned with little or no vibration. Vibration is usually caused by the wood being unbalanced in weight, and is particularly common before the wood has been rough turned down to round. Low speeds are needed to reduce the vibration until the work becomes balanced, then speeds can be increased for more efficient turning.

Suggested lathe speeds for various diameters of spindle stock are given below. If there is a question regarding whether a lathe rpm is set too high, chances are it is. It is best to work on the side of caution. A slower lathe speed may require more time to remove the excess stock, but will allow for safety turning. Cutting principles remain constant regardless of lathe speed.

Suggested Lathe Speeds

Diameter of Stock	Lathe Speed
1" or less	3,000 rpm
1.5 "	2,500 rpm
2"	2,000 rpm
3"	1,500 rpm

SAFETY

Personal Protection Equipment (PPE)

Face Shield

Having at least minimal protection in place to reduce the chances that these projectiles will reach and damage the eyes should be a common sense no-brainer for ANYONE who intends to stand at the lathe,



It is advisable to select a face shield that is not simply a piece of plastic hanging from a headband, but one which includes lower face and jaw protection as well.

Respiratory Protection

Another safety issue involving the use of personal protection equipment involves ensuring that the operator is adequately protected from fine wood dust carried in inhaled air. Since inhaled fine particulates can represent a significant health risk, particularly in repeated exposures over extended periods of time, it is particularly important that this aspect of woodturning safety be treated very seriously.

Installation of an efficient dust collection capability in the classroom workstation is recommended. Respiratory PPE involves specific devices that are used to eliminate or reduce the possibility of inhaling fine air-suspended particles deep into the lungs.

Face masks are recommended for protection from wood dust generated during sanding, this is the greatest respiratory health risk.



Hearing Protection

In general, woodturning at the lathe is a fairly quiet endeavor, especially when compared to running other woodshop machinery such as surface planers, jointers, miter saws, and table saws.

There are numerous kinds of hearing protection (Hearing Protection Devices, HPD) available in different designs. Some prefer an earmuff style hearing protector, with a spring-tension band that can be worn over the top of the head, behind the head, or even under the chin. Others prefer hearing protection that inserts into the outer ear canal as an ear plug which attenuates high noise levels before they reach the ear drum and inner ear anatomy.



...it is particularly important that this aspect of woodturning safety be treated very seriously.

TEACHING TIPS

Tips for Teaching Young Turners

The major difference between teaching youth and adults is that young turners have little or no experience with power tools and little knowledge of how dangerous power tools can be. They also have no fear and can be very aggressive and just stick their tools into the work piece, not realizing how dangerous that can be. On the bright side, they present a clean slate and come to the lathe with few prior bad habits. On the plus side, they possess a good deal of passion and enthusiasm, that when properly channeled can lead to a very rewarding experience for the student and the teacher. Minimum time can be spent on teaching skills, as a young student's attention span tends to be short and they enjoy making the chips fly.

The instructor needs to take the time to choose and prepare projects that are simple, fun, and of interest to the student. The projects can then progress through more and more difficult projects that build on skills and still keep the students interested. One of the reasons that Let's Go for a Spin is such an effective teaching tool is the variety of projects that can be selected and adapted to teach and aid in the learning of the many skills needed to become a good turner. I have found that a few young turners are interested and will spend a short amount of time on skill-building exercises. For the most part, it is the finishing of a project in a short time period that attracts youth to woodturning. The

amount of time that a younger student has to spend in the classroom or at the lathe is somewhat restricted, so a great deal of time and effort needs to be spent by the instructor to provide a well-organized and flowing session that enables the student to complete a project that interests them, gives them a feeling of success, and helps to build their self-esteem.

Give them a feel for how much fun woodturning can be and that it is a rewarding hobby. When looking for fun projects, be sure to check the resource guide in the Let's Go for a Spin appendix or develop some of your own interesting projects. Better yet, encourage the students to develop their own ideas and designs. Encourage them to go off in another direction if they choose to do so; do not force them to create an exact copy of the project selected. After all, most of their time in the classroom is spent regurgitating what they are taught and they are given few opportunities to be creative. The lathe should be an opportunity for them to have fun, be creative, and explore shapes and forms. Most of all, try to keep the session fast-paced, fun, interesting, and productive.



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The following tips may aid your teaching experience.

- Keep an eye on the students for safety concerns and be alert to any lack of understanding or, just as importantly, signs of boredom or loss of interest.
- Be ready to adjust the pace of the class to better match the needs and desires of the students.
- Remember that not all students learn at the same rate and that some learn by watching, some by reading, and most by hands-on experience, so be prepared to use a variety of media and methods to help your students learn in the manner most comfortable for them.
- If a student does not understand what you are teaching, try another approach to get your point across. Always be alert to signs of incomprehension and provide alternative explanations.
- Height of the lathe: Young turners are generally shorter than adults, therefore the height of the lathe may need to be lowered or a stand or platform can be provided to raise the young turner to the proper height for comfortable turning.
- Use examples: Examples of turnings can enhance a young turner's interest in woodturning and may spark some new ideas.
- Balance helpfulness: Young and older turners appreciate being allowed to do most of the turning themselves, so that they feel ownership of the work.
- Do not be too critical of the students' work. If they are having fun at the lathe, that is what counts, not producing an exact copy of the project.
- Build on experience: Teach in incremental steps that allow the young turner to begin with simple skill-building exercises and projects and to progress to more complicated skills as confidence grows.
- Ensure success: Help students master each step before tackling the more difficult steps.
- Use of mini lathes: Small lathes are less threatening and the height is easier to adjust than full-size lathes.
- By using belt-driven lathes, the instructor can more easily establish the lathe speed and ensure that it remains set. Also the belt can be adjusted such that aggressive tool use will cause the blank to stop, thus minimizing potential injuries.
- Use dead centers (sometimes referred to as cup centers or safety centers): Tighten the centers firmly but not too tight, so that any aggressive tool use or a catch will stop the blank. It sometimes helps to loosen the drive belt a tad so that it will slip under aggressive or unsafe use.

- Use wood such as maple or poplar which is easy to turn and is in good condition, free of cracks, knots, or other defects.
- Do not allow young turners to use drills, drill presses, band saws, chain saws, etc. unless they have been trained in their proper and safe use or have documented proficiency in their use.
- Try to keep the ratio of adults or spotters as close to one-on-one per student as possible.
- Enjoyment: The emphasis of instruction should be on the enjoyment of turning fun projects and having a good, rewarding time on the lathe spinning wood. Try not to over-emphasize tool technique, as young students will quickly lose interest if too much time is spent on demonstrations or on working to develop good tool control and technique. Try to select projects that will, through the making of the project, help teach or improve tool skills and knowledge.

Above all, keep the pace lively and fun.

~Alan Leland

BEST PRACTICES



First Cuts: ABC's

One recommendation is that you have every student remember the A B C's:

Anchor – **B**evel – **C**ut

Anchor:

Set the tool firmly on the tool rest. Explain that the forces of the cut must be taken by the tool rest in as direct a manner as possible.

Bevel:

Instruct the students to always begin with the handle low, so that the bevel is the first part of the tool steel that contacts the spinning wood.

Cut:

Slowly raise the handle until the edge engages the wood and begins to cut a shaving. Keep the handle as low as is possible while still producing a shaving.

Direction of Cut

When spindle turning, teach students to cut “downhill” from large diameter to small diameter.

Bevel Contact

Constantly bring their awareness to the importance of bevel contact. The bevel being in contact with the wood is what gives the turner control of the tool. When the bevel loses contact with the wood, a catch is likely to occur.

Stance

Proper stance and body mechanics are paramount in helping student progress.

BEST PRACTICES



Before Turning on the Lathe

Checklist

A short checklist will assure that students are ready to turn on the lathe:

1. Face shield on
2. Blank properly mounted between centers: drive center point engaged in the end-grain
3. Tailstock base firmly locked
4. Tailstock ram not extended too far out, and live center pressed into the end-grain
5. Tailstock ram locked
6. Tool rest base locked firmly in position
7. Tool rest set at proper height and distance from the wood to avoid contact

Free rotation

Instruct students to spin the outboard hand-wheel with their left hand before turning on the lathe, just to confirm that the wood won't strike the tool rest. If this is always done before they turn the lathe on, they will avoid problems after re-positioning the tool rest.

On and off

Direct the students to practice starting and stopping the lathe a few times before actually taking any cuts. They should be able to find the switch and quickly stop the lathe in a matter of seconds. Teach them to listen for inappropriate or unusual sounds.

BEST PRACTICES

Lesson Plans & Handouts

A good handout is important to the success teaching because it will help the student better understand the steps involved in completing the turning and serve as a guide to take home with them. You should know approximately how many will attend so you have enough handouts for everyone. Your introduction to the students should include the following elements:

- **Title:** Should be descriptive
- **Introduction:** Statement about the turning and an overview of the project itself
- **Design Considerations:** A short explanation about the turning's design
- **Wood:** Should include wood used, recommended or not recommended, if appropriate
- **Tools:** Should also include accessories
- **Materials:** This includes such things as dyes, paints, etc.
- **Steps:** Logical steps from start to finish
- **Measurements:** These are particularly helpful to new turners
- **Illustrations:** Should include both pictures and drawings
- **Sources of Materials:** Include name, address, web site, and phone number
- **Suggestions for Further Study:** If appropriate, it can be very helpful

Remember to carefully proofread your handout and be sure to double-check all measurements and illustrations.

“Beta test” the handout to make sure it is useful and correct. Use the handout yourself to complete the turning or, ideally, have another turner try to use it.

AAW has provided resources for many projects that may be used for your classes. If you have additional projects not already covered, please consider sharing your handout.



BEST PRACTICES

Workshop Environment & Protocol



Lathe Arrangements

Being able to freely walk around each lathe has many instructional advantages for both instructor and student.

Staggering the lathes or setting them at a slight diagonal to a wall prevents a student from standing in the “throw line” of an adjacent lathe. This is less important with spindle work than when bowl turning where there is a greater chance of “flying objects” suddenly appearing. There are better ways of making a turning session memorable than being clobbered by a wooden projectile. In some turning schools, each turning station is divided by a screen, wall section, or tool panel. Where a tool panel is not provided it is important to have a small table or cart where students can place their individual tools. They should be encouraged to avoid placing their tools on the lathe bed.

Lathe Speed

Check each lathe for appropriate start-up speed

Spindle Height

Try to adjust the spindle height in relation to the student who will be using that particular lathe. A good rule of thumb is that the spindle height should be somewhere around the same distance from the floor as a person’s heart. It should be no lower than their elbow while standing in a relaxed position.

Floor Mats

Having a good rubber mat to stand on instead of a hard concrete floor helps reduce leg and back fatigue. A mat can also reduce damage to dropped tools.

Lighting

Adequate lighting is important not only for seeing the work but also for reducing eye fatigue and, over time, eye damage. Ideally each station should have good overhead lighting as well as a moveable work lamp to provide more direct light on the project. Lights which have protective shields are recommended.

Extension Cords

Use of extension cords that cross traffic areas should be avoided.

Protection for Eyes, Ears & Lungs

Be sure to wear eye protection whenever demonstrating. Full face shields provide the most protection. Teach the students how to properly adjust the hand-band and how to lift the shield for talking. Face shields should be kept clean and free of scratches.

Hearing protection and dust protection should be recommended and should be made available to students. Mention that some people are particularly bothered by dust from woods such as cocobolo and other exotics, and that precautions should be taken to avoid breathing fine dust whenever possible.

BEST PRACTICES

General Shop Guidelines



ALL students are expected to follow **ALL** safety rules at **ALL** times.

- Treat everyone with respect.
- The use of stereo headphones is not allowed while using power tools.
- Safety glasses must be worn at all times when using power tools.
- Face shields must be worn while using a lathe.
- Long hair must be pulled back securely while using power tools and lathe.
- Loose clothing is not permitted while using power tools and lathe.
- Open-toed shoes are not permitted.
- Students may only be present in the shop during posted, supervised shop hours.
- If you break a tool (accidents happen) or you find a broken tool, inform an instructor.
- Clean up must begin 15-prior to the end of class.
 - ✓ Clean up after yourself.
 - ✓ Shop tools should be left cleaner than you found them.
 - ✓ Sweep off the lathe before using the air hose or vacuum.
 - ✓ If the vacuum is not working properly, empty it and blow out the filter.
 - ✓ All equipment must be cleaned and put away.

STUDENT PROJECT

Bottle Stoppers

Bottle stoppers are fun projects that allow students to complete two or three during a turning lesson. Design opportunities are limited only by one's imagination. This is an excellent project for each participant to practice tool techniques and forms.

This project is an excellent way to use smaller blocks and scraps of wood that are accumulating in your shop. Squares also can be laminated with different woods before the turning lesson. There may be differences in bottle stopper kits and whether or not you're making a cork stopper.

Tools

- Face shield
- Roughing gouge
- 3/8" spindle gouge
- Round nose scraper (optional)
- Sandpaper strips 120 grit to 600 grit
- Sanding sealer or friction polish
- Buffing system – Tripoli/White diamond (optional)
- Bottle stopper kit and mandrel
- Wood blanks 1-1/2" x 1 1/2" x 2" or 3"
- Drill press with required drill bit
- Jacobs chuck with Morse taper

Process

Before the turning session, cut your wood blanks into 1 1/2" squares by 2" - 3" long. Depending on the kit manufacturer, a 2" long blank may limit designs a bit. Make sure the blanks are square for drilling the hole and a good fit to the stopper bottoms.





Pictured above is the Jacobs chuck that will hold the bottle stopper mandrel. Depending on the kit manufacturer or style of bottle stopper made, each mounting system for stopper blanks will vary a bit. The drill bit has masking tape on it to mark the 1" drilling depth required.



Use a jig to drill the stopper blank holes 1" or according to kit recommendations. Pictured above is a simple jig made by cutting a 90 degree angle in a piece of wood along with a parallel side, allowing clamping of the blank. It's recommended that the stopper blanks be drilled before the turning session.

Screw the bottle stopper onto the mandrel. Bring the tail stock with a live center up to the blank for support. Round the blank with your roughing gouge.



Turn the base of the blank down to the mandrel bushing, establishing the base. Don't make the first 1" of the blank from the base too thin. Remind the students that the bottle stopper base screws in at this point and needs some strength.

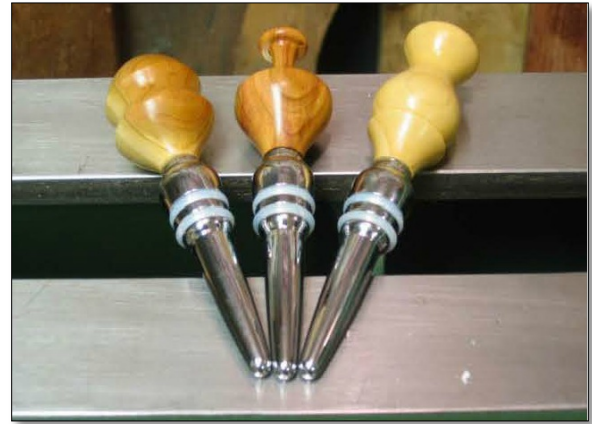


Once you have turned your stopper design, sand the stopper thoroughly with 600 grit.

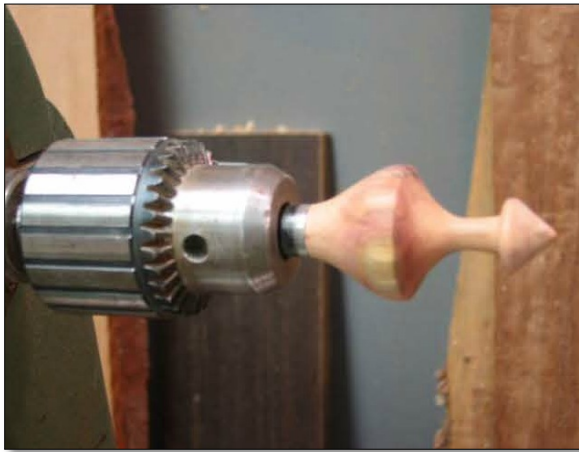


Back off the tail stock and turn away the nub that's left and then sand. When done, apply the finish of your choice. Friction finish or sanding sealer followed with Tripoli and White diamond buffing wheels are good choices. They are relatively easy and quick, allowing completion during the turning session.

When screwing the turned bottle stopper tops onto the bottoms, use a few drips of CA glue or 5-minute epoxy in the hole to help set the treads.



~ Dave Bowers



STUDENT PROJECT

Christmas Ornaments

Tools & Supplies

- Christmas ornament kit
- Wood
- 7mm drill bit
- Drill press
- Adhesive
- Barrel trimmer
- Hand drill
- Pen mandrel with Slimline pen bushings
- Wood spacer
- Ball-bearing cone center
- Spindle roughing gouge or shallow spindle gouge
- 3/8" spindle gouge
- Abrasives 120 grit through 400 grit
- Wire burner
- Colored markers
- Wood bleach
- Wood dyes
- Carving tools
- Pyrography tool
- Finish
- Vise or clamp with wood or plastic jaws

Steps

1. Prepare the blank.

This ornament requires the use of a commercial Christmas ornament kit that includes an upper eye cap, brass tube, and lower decorative tip. Select a piece of wood between 1" and 4" square and cut it to 1/8" longer than the brass tube. Light colored woods show up best when hung on a Christmas tree.

2. Prepare the blank.

Drill a 7mm hole through the center of the blank. Spread a thin layer of glue inside the hole and on the outside of the brass tube. Glue the brass tube inside the hole. Use thick CA glue, epoxy or urethane glue.

3. Prepare the blank.

Use a barrel trimmer to cut the wood flush and square to the ends of the brass tube.

4. Mount the blank on the lathe.

Secure a pen mandrel between the headstock and tailstock of the lathe. Position the ornament blank between two bushings on the mandrel. It is usually necessary to include a wood spacer on the mandrel before tightening to the brass nut. Apply light pressure from the tailstock, then tighten the brass nut using firm hand pressure.

5. Turn the ornament.

Turn the ornament to the desired shape. Remove the square corners of the wood using a spindle roughing gouge or shallow spindle gouge, then shape the ornament with a 3/8" spindle gouge. The diameter of the wood at the ends should be slightly larger than that of the bushings.

6. Sand the ornament.

Thoroughly sand the ornament. The diameter of the wood after sanding should be the same diameter as the bushings. The final sanding should be done, working parallel to the grain while the lathe is stopped.

7. Decorate the ornament.

Decorate the ornament as desired using a combination of wire burning, coloring with markers, bleaching, carving, dying, branding with a pyrography tool, etc.

8. Apply finish.

If coloring is used in the decorating process, take care to prevent smearing the ink or dye. A light lacquer finish applied from an aerosol spray can works well for this.

9. Assemble the ornament.

Using a vise or clamp with wood or plastic jaws, press the eye cap into the top end of the brass tube and press the decorative lower tip into the bottom end of the tube.

~ Kip Christensen

STUDENT PROJECT



Gavels

This is a project the kids of all ages love to do. Sherry and I have used this project with kids as young as 8 and I've done it with junior high and high school students. Like many other projects it can be done at all skill levels. Our students have reported using their gavels at mock courts in schools even as crab mallets, and as gifts. One student turned a strike to make a special gift for his grandfather.

With younger students ages 10-12 we use one 2.5 hour class to turn the head and a second 2.5 hour class to turn the handle. Older students in a five day class can turn the head and handle in about 3 hours on the 3rd day after mastering the basics.

Gavel Head Supplies

- Blank size 2" x 2" x 3" hardwood such as maple, cherry, walnut, locust
- Face Shield
- Disposable dust mask
- Spindle roughing gouge
- Parting tool
- 1/4 or 3/8 spindle gouge
- 1/2 drill bit, drill press, vee board, masking tape or hand drill
- Ruler
- Sandpaper, walnut oil
- Hacksaw

Design Considerations

Most important is a rounded edge leading to striking face otherwise the head will split or chip. Symmetric designs generally look the better than asymmetric ones.



Class Format

We begin each class with a review of the safety rules. We then spend about 40 minutes with a warm up block. In this case a 2x2x3 poplar or soft maple that the students practice beads and coves and parting. The project and the warm-up/practice exercises are taught by showing a step then have the students do it.



Each time reviewing how the tool is used. Below I'll use ***** where I would break from the demo.

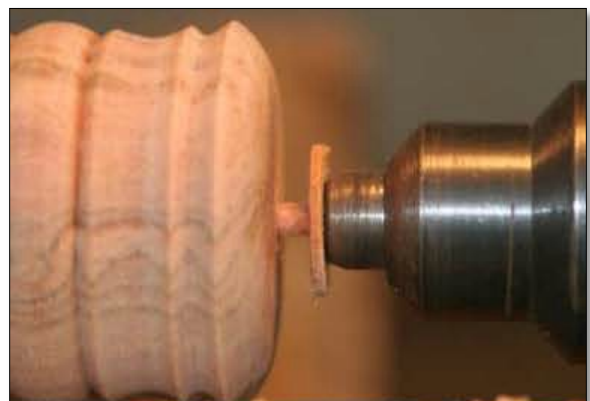


Turning

1. Mount between centers.
2. Rough to a cylinder with spindle roughing gouge
3. Part in at each end to a 1" diameter to mark off the head leaving a 1" tenon on both ends to hold the work.



4. Lay out the design. The students can design their own using combinations of beads, coves, and flats. I show a simple design with a bead on each end and a large bead between. I extend the bead on each end over the striking face to the 1" tenon.



5. Sand the surfaces with 120 and 220

6. Part in on the tailstock face and then on the headstock face. Students need to make this slightly convex. Students should part in to slightly less than a pencil diameter. More able students can take this into 1/8 inch.



7. Remove from the lathe and saw off the tenon from each end. I have the students use a small hacksaw for this. I usually hold the head and keep my body parts away from the saw. Most young turners have a great difficulty sawing. I stress not pushing down on the saw and letting the weight of the saw be enough to feed it into the work.

8. Sand the sawn surface. I will have a 3" 120 grit disc on a drill, followed by a piece of 220 on a table. The students run the face back and forth over the paper. Using the 3" disk often requires two people - an instructor or other student to hold the drill and a student holding their gavel head against the disc.

9. Students then select and mark the mortis hole to receive the handle. I tell them the handle has to go in one of the circles. You can say face grain but why? I also suggest they decide which circles look the prettiest as this will be what folks see when the gavel is laying on the table so put the hole on the other side.

10. We had a drill press at MD Hall. I mounted a vee board to position the gavel head. Put a piece of tape on the drill bit to mark the mortise hole 3/4" deep.

11. I hold the gavel head and the students turn on the drill press and feed the drill into the wood. I have them practice turning the machine on/off and explain to them to back the drill bit out when I said "up".



Gavel Handle Supplies

- Blank size 1 "x 1 "x 1 0" hardwood matching the head such as maple, cherry, walnut, locust
- Face Shield
- Disposable dust mask
- Spindle roughing gouge
- Parting tool
- 1/4 or 3/8 spindle gouge
- Ruler
- Sandpaper, walnut oil
- Hacksaw

Design considerations

We tell the students that a bead where the handle joins the head will hide the joint in a shadow. Also there is a length that looks good with each head. We would have 5 or 6 handles for the students to use for deciding on a length of then handles for their gavel head. When turning the handle we talk about making it something than feels good in their hand.

Class Format

We begin each class with a review of the safety rules. We then spend about 40 minutes with a warm up block. In this case a 2x2x3 poplar or soft maple that the students practice beads and coves and parting. The project and the warm-up/practice exercises are taught by showing a step, then have the students do it. Each time reviewing how the tool is used.

Below I'll use ***** where I would break from the demo.

Turning

1. Mount between centers

2. Rough to a cylinder using the spindle roughing gouge.

3. The tenon can be turned on either end. It is best if one of the centers is small enough to allow turning the tenon on one end. The Maryland Hall lathes had a small cone center and we could have the students turn down to W' and test fit. The tenon can be turned on the headstock side if you have a small cup or steb center to drive the work.

4. Making the tenon begins with marking a 3/4 inch length (don't expect a 12 year old to know how to measure 3/4 of an inch) set the calipers on a 1/2 drill bit. Part in on the very end; stop the lathe and test with the calipers. Then part in the length of the tenon just a bit larger in diameter. Test fit using either the head itself or a wood strip with 1/2" diameter hole. Keep working with the parting tool until the oak strip just slides the full length. If the tenon is too small in diameter they can work back in 1/4 inch lengths. The oak strip can still be used for the test fit.

5. Make a part in 1/8" inch to mark the length of the handle. Then turn the handle and part in to less than the thickness of a pencil. Here we let some students cut the handle free with the spindle gouge with an instructor holding the handle until it is free. Alternatively, the waste could be sawn off.

6. The student may then test fit the handle into the head. When the whole class can hold their handles and not have the heads fall off we tip our hats to the class and tell them what fine tenons they have.

7. If a tenon is loose I put a turn of masking tape being sure to leave bare wood on either side of the tape and test fit.

8. We then glue the heads on with Tite-bond or something similar. The students then finish with walnut oil. I instruct them to be careful not to turn the handle when wiping off the excess oil and not to turn it by accident for overnight

~ Sherry & Al Hockenbery
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STUDENT PROJECT

Goblets

Goblets have been around for centuries with many design and style variations of the basic shape. Reference your glass goblets at home, in stores, or catalogs for ideas. This project will blend spindle turning with some end-grain techniques to produce excellent results.

Tools

- Face-shield
- Roughing gouge
- 3/8" spindle or detail gouge
- Parting tool
- Sand paper
- Jacobs chuck

Process

Use the roughing gouge to round the blank between centers. Turn a tenon on one end and face off the other end with the parting tool. The tenon becomes the base in the 4-jaw chuck. In the absence of a 4-jaw chuck, use a face plate with a waste block. True up the waste block and turn a recess to match the tenon on the blank. Glue the blank into the waste block with quality glue, avoiding CA because of its brittleness.



If face plates with glue blocks are being used, prepare the blanks and glue blocks before the youth turning event. Ensure the gluing surfaces are true for a good joint.

Set the tenon into the 4-jaw chuck. The tenon should seat on the top of the jaws and not bottom out on the inside. If a glue block is used, the tenon should not bottom out in the glue block either.

Drill a hole to desired depth using a Jacobs chuck or a 3/8" spindle gouge. A Jacobs chuck with a 3/8" drill bit in the tail stock is an excellent method to accomplish this. Each mentor should give extra attention to this procedure or perform it for the student if the situation requires.



Hollow the bowl to shape, practicing end-grain turning techniques. Sand the inside of the bowl.

Turn the outside of the bowl to match the inside and sand. Leave the area where the stem will meet the bowl for the next step.



Place some loosely packed paper towels in the bowl of the goblet and lightly bring up the live center until it just begins to spin. This will steady the bowl when turning a slender stem.

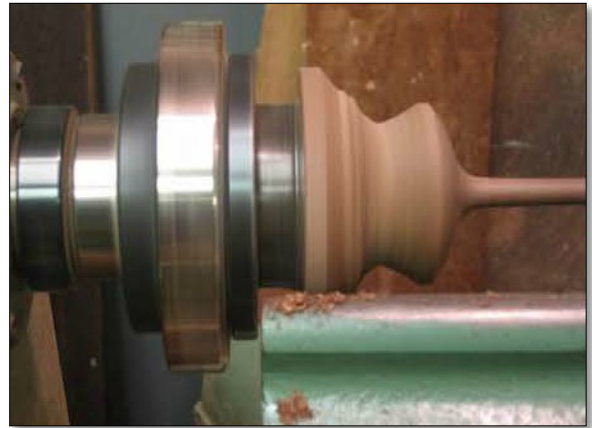
Starting at the bowl end, turn the stem down to the final size in 1" increments.

Sand each section and continue until you have the length of stem that you wish.

If you're turning a slender stem, keep the lathe running from this point on. The torque of starting and stopping the lathe can shear the stem. The mentor may need to help support the slender stem or demonstrate how to support, keeping vibration down.

Although a slender stem is very elegant, variations might include a stem that flares out to the base, uses beads and coves, or other design elements.

Shape the top of the goblet's base, blending it with the stem.



After sanding the top of the base, part the goblet with an undercut. When using the parting tool, keep the cut 2 to 3 times the width of the tool.



Sand the bottom of the base and apply your favorite finish.



A handy sanding aid can be made by rounding over the remaining wood after parting the goblet. Glue on a piece of 220 grit sand paper and gently sand the bottom.

~ Dave Bowers

STUDENT PROJECT

Honey Dipper

This is a fun, simple spindle-turning project that teaches several basic skills while producing an attractive and useful gift.

NOTE: These instructions assume you have a coach or are already skilled in basic turning. If you are new at turning and on your own, there is a more detailed instruction sheet available.

Be safe.
Have fun.
Stay sharp.
A-B-C.

Materials Needed

- A turning blank about 1" x 1" and 6 ½"-7" long
- I like fruitwood (apple, plum, cherry) because it has a terrific natural, rustic look and seems an appropriate fit with honey. Fruitwood also splits so readily it is hard to get bowl and box blanks out of it, so this makes good use of the wood.

Note: If cured fruitwood is not readily available, hard maple, even uncured, is acceptable wood to turn honey dippers and are more widely available.

Tools/Supplies

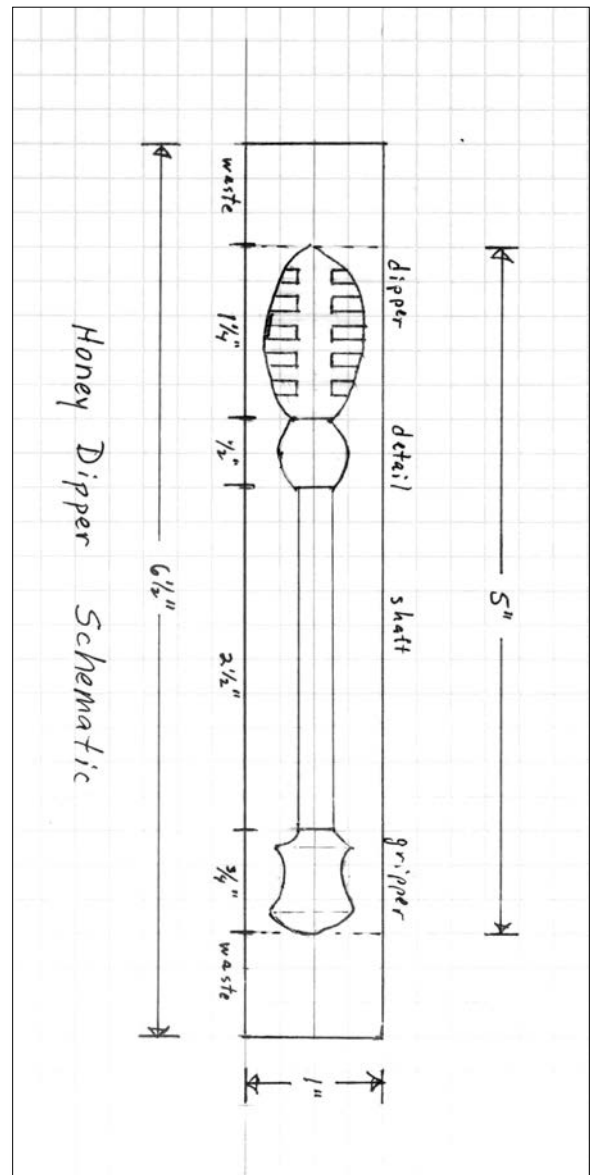
- Safety equipment
- Pencil
- Ruler
- Sharpening equipment
- Spindle roughing gouge
- 3/8" +/- roughing gouge OR 3/4" or larger skew chisel
- 1/6" parting tool
- Sandpaper (120, 180, 240, 320 grits)
- Finished Honey Dippers
- Oil finish



Instructions

1. Mount the blank between centers.
2. Rough turn into a cylinder with the roughing gouge, then smooth the surface with a shearing cut with the skew or spindle gouge. (Tip: Leave $\frac{1}{2}$ " at the headstock end unturned as the blank starts out just about the minimum diameter for the usual drive center.)
3. With the lathe off, choose the best 5" section of the blank, leaving adequate waste at the ends, and mark off the sections of the dipper. Mark $1\frac{1}{4}$ " from whichever end you like for the dipper end, mark off the next $\frac{1}{2}$ " for a little detail work, and mark the $\frac{3}{4}$ " at the opposite end for the gripping part of the dipper (see schematic). I like to cut a narrow V groove at each pencil mark with the long point of the skew so the marks last longer as I work. While you're at it, cut a little off the inner edges of the waste with some V cuts to give yourself some elbow room.

There are many ways to proceed from here, but I will present the steps in the order I prefer to do them. You can change the order, but they all will need to be done.



4. I generally decrease the diameter of the long middle section and the $\frac{1}{2}$ " and $\frac{3}{4}$ " section to emphasize what I'm going to do with each part and suggest the final shape of the dipper. The $\frac{1}{2}$ " and $\frac{3}{4}$ " long sections I make about $\frac{5}{8}$ "- $\frac{3}{4}$ " diameter at this point and the long center section about $\frac{1}{2}$ "- $\frac{5}{8}$ " (Tip: Don't make the long section too skinny or the wood will flex while you do the other steps.).

5. At the 1 ¼" section at one end, use the skew or spindle gouge to round the ends of the section. Your goal is a rugby football shape (or a solid ellipse if you remember sophomore geometry). You are rolling a very long bead.

6. At the adjacent ½" section, use the skew or spindle gouge to make whatever shape or detail suits your fancy.

7. At the ¾" section at the opposite end make a shape or detail work that pleases you, keeping in mind that this will be the grasped end of the dipper. (Tip: Don't cut the waste too thin here, yet.)



8. Returning to the rugby football section, use the 1/16" parting tool to cut the football into segments, like ribs. I think it looks best if the ribs are all the same width and narrower looks better than wider. It takes a lot of practice to judge the spacing of the cuts and have them come out looking the way you want. You might want to mark them off the first few times you do this part, or just wing it and have an

excuse to turn another dipper. Cut down perpendicular to the lathe axis and to the same depth at each point. I like to cut down to a diameter that will be the same as what I'll make the shaft.

9. Use the skew or spindle gouge in a shearing cut to thin the long section to the diameter that looks good to you. I like to make it in a consistent diameter, which is challenging at first. You may prefer it tapered or shaped in some way. It's up to you what diameter to make, but I generally find ¼"-5/16" to be most pleasing.

10. Adjust your lathe to a slow speed, and sand, starting with 10-100 grit and going up stepwise to 320. If you've done a nice shearing cut, you may be able to start with a finer grit. Take care not to soften or round the sharp details you've made. (Tip: in between grits, turn off the lathe and gently sand the long section lengthwise to more effectively remove sanding marks.)

11. After sanding, wipe off your work with a paper towel moistened with alcohol or mineral spirits. Then apply your finish of choice. I like a "drying oil" for dippers (tung or walnut oil). Make sure you get finish in between the ribs at the honey end of the dipper, and also that you remove any excess as well.



12. As the first step in parting off, I like to thin down the tailstock waste material to 1/8" or so, since I always do my final cut at the headstock end. When the tailstock end is thinned out, do the same on the waste at the headstock end, continuing to cut until the dipper is parted off. Make sure you leave a little nub on the end of the dipper, so you don't flatten the nicely rounded end you worked so hard to make.

13. Cut off the waste at the tailstock end and sand off the nubs at both ends with coarse sandpaper. Twisting the tailstock waste off tends to leave a hole in the end of the dipper. (Tip: put a piece of sandpaper in your palm and rotate the end of the dipper against it to produce a nicely rounded end.) Once the nubs are gone, move up through the sandpaper grits to 320 grit.

14. Apply some of the finish to the ends, as you did before. You may want to apply another coat of oil finish in 4 to 24 hours. The oil finish needs a week or so to cure prior to the dipper being used. If you used something other than oil finish, you will need to follow your preferred practice on recoating and time to cure.

If this is your first project, congratulations - you're a woodturner! (And there is no escape.)

STUDENT PROJECT

Key Chains

Turning key chains is a good way to practice your turning skills and various finishing techniques. In this tutorial, I am turning a keychain that has larger ends, but the techniques are the same for most 7mm keychain kits. You can either buy the bushings or turn the body with ends slightly larger than 7mm pen bushings to save money on parts. As with turning any item, remember to wear face shield and eye protection at all times.

Supplies

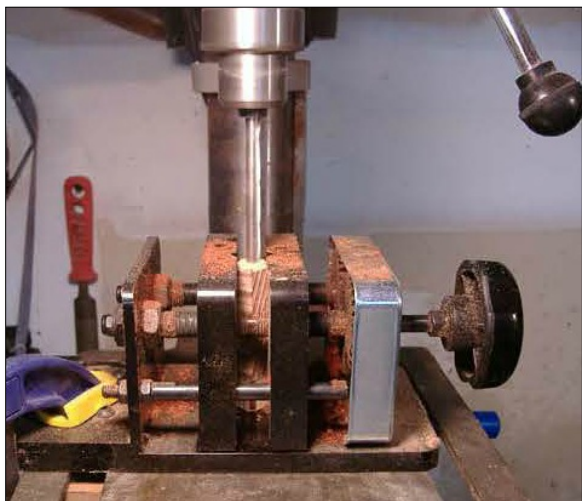
- 5/8" x 5 1/2" wood blank – this standard pen blank size will give you two keychain blanks
- Face shield
- 7 mm keychain kit
- Keychain mandrel
- Keychain bushings
- Barrel trimmer
- Roughing gouge
- Spindle gouge or skew chisel
- Sandpaper (120-600 grits)
- Finishing supplies

Process

Begin by drawing the cut lines on your wood blank. I use the keychain tube to do this because kits may vary slightly. Place the tube on the blank and draw a line where it ends. Use a saw to cut the wood blank to size.



The next step is to drill the wood with a 7 mm drill bit. Use a clamping system or a drill bit vise to hold the wood securely. If possible, clamp the vise or pen clamp to the drill press for safety. If you are drilling by hand, clamp the wood blank to a counter table while you drill. If you try to hold it and the drill bit goes through the side, you can hurt yourself.



With the wood blanks drilled, it's time to glue in the tubes. Spread some thin or "flexible" CA glue on the keychain tube and push it quickly into the wood blank. Make sure the tube ends up in the blank and not sticking out of the other side. One cheap tool that works great for inserting keychain tubes is a pencil. Other glues with longer drying time may be used. This might be a good break time to demonstrate the next few steps.



Let the glue dry a few minutes and then use a barrel trimmer to square the ends of the wood to the tube. Note that the wood blank is clamped to the counter for safety.



Now for the turning part. Mount the keychain blank on your keychain mandrel with the bushings. Set your toolrest close to the work without hitting it. Spin the wood by hand to ensure it clears the toolrest. If everything is OK, turn the lathe on. Using a roughing gouge, work the keychain blanks down to a cylinder. Leaving the blank a bit bigger than the bushings will give you room to make decorative design decisions, if you want.

With your spindle gouge or skew chisel, turn the blanks to their final size and design. Try not to turn away any material from your bushings or you'll have to get new ones to turn

your next keychain. Notice for this kit, the ends are bigger than the bushings.



Once you have finished turning the keychain, it's time to sand. Move the toolrest out of the way and sand from the bottom of the keychain. Start with 120 grit and work your way to 600 grit. If you notice deep sanding marks, stop the lathe and sand by hand along the length of the keychain. This should get rid of them. Once the marks are gone, finish going through the grits.



When the keychain is sanded, apply the finish of your choice. The mentor may have a few options for you to use. A few suggestions are friction polish or woodturner's wax. Explore each of

them to find your personal favorite. On my keychain, I used friction polish. To use it, stop the lathe, put a few drops of polish on a paper towel and rub it on the keychain. Turn the lathe on and lightly rub again from the bottom to polish the finish to a high shine.



With the keychain turned and finished, remove it from the mandrel and arrange the parts to be pressed into the keychain blanks. A drill press is the easiest way to do this, but if you don't have access to one, use a hand clamp.



With the parts pressed together, attach the keychain ring, and you're finished!



~ Chris Wright

STUDENT PROJECT

Lidded Box

Lidded boxes are a fun project that can have simple lines or highly decorative work, and it can be a challenge to get a good-fitting lid. This is one version of the box project that I enjoy creating.

Supplies

- Straight grained wood turning square – 3"x3"x6" (box)
- ½"x ½"x5" contrasting wood pen blank such as ebony (optional)
- Face shield
- Thin kerf hand saw (optional)
- ¾" spindle roughing gouge
- 3/8" spindle gouge or detail gouge
- ¼" parting tool
- ¼" box scraper
- ½" skew – not oval, not radius-edged
- 1/16" narrow parting tool
- Vernier calipers
- Wood glue (Titebond or yellow glue)
- Sorby multi-tip tool with rounded bit (or other small hollowing tool)
- Jacob chuck for tailstock
- Finish – Danish oil, Mahoney's walnut oil
- Drill with bit (5/32" works fine)

Process

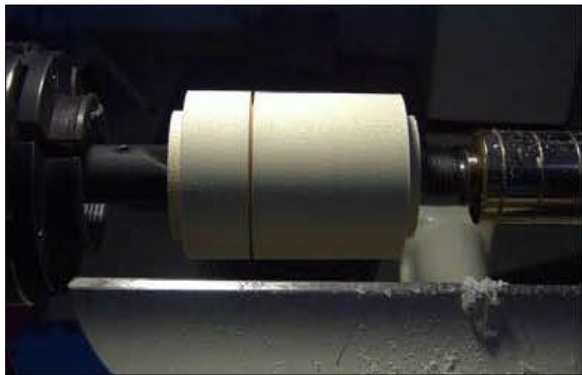
Mount the wood blank between the centers, rough into a cylinder, and make tenons on both ends with 1/4" parting tool for mounting in chuck jaws.



With the 1/16" narrow parting tool, make a parting cut approximately 1-1/2" to 2" from one end of the blank. Don't make a cut and widen the cut



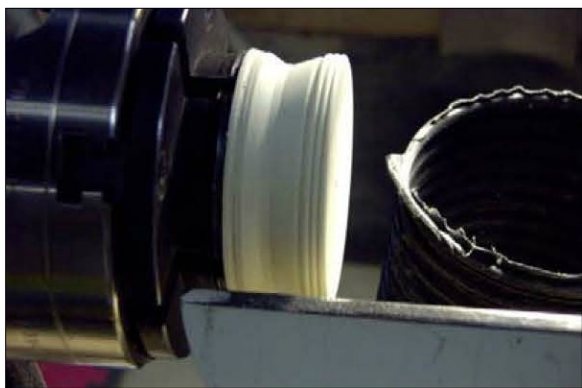
slightly to keep the tool from being grabbed by the wood.



Turn the lathe off. Use the thin kerf hand saw to separate the pieces. Rotate the piece by hand every few strokes to keep the wood from pinching the saw.

Mount the smaller piece in the chuck. This is your lid. True up the sides with the spindle gouge and the face with the 1/4" parting tool. Make sure all saw marks are removed.

Shape the outside of the lid. Beads, V-grooves, and burn lines are good for disguising the joint. Partially shape the dome of the lid but leave plenty of material to provide support while hollowing the lid.



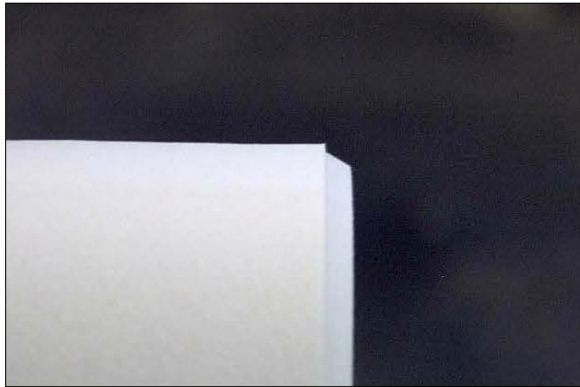
Hollow the lid. Leave an oversized nub in the center to allow room to drill a hole for the finial in the other side. Don't make the lid too thin or it will break when the finial is pulled on to open the box. Using the box scraper, cut a spigot near the inside edge of the lid. Keep the sides parallel.

A finial adds a wonderful touch, but if it is not desired turn the center of the lid as necessary.



Shape the dome of the lid, leaving enough material to help support sanding. Sand outer rim and inside of lid. When done, part the lid and put aside. Mount the remaining piece of wood in the chuck. This is the box body. True up sides and face, removing all saw marks.

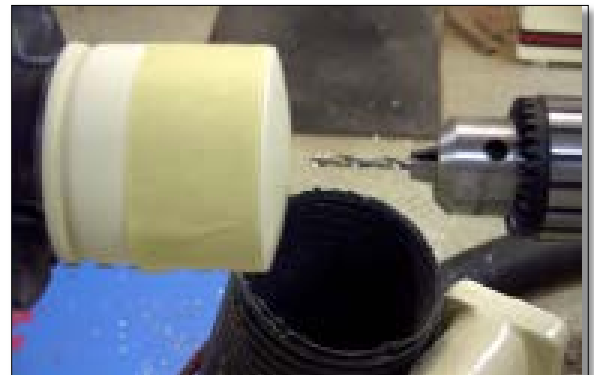
Cut the tenon on the box body. Using the skew on its side with the toe toward the headstock and the cutting edge at about a 45° angle to the lathe bed, cut an angled tenon. Stop frequently to math up the lid. As soon as the lid fits over the very edge of the tenon, it's time to straighten it out.



To straighten the tenon, use the skew with the toe toward the headstock and the cutting edge parallel to the lathe bed. Cut straight forward until you reach the point where the lid fits over the edge of the tenon. It's best to stop frequently and keep testing the fit. Ensure you keep the sides of the tenon perfectly straight.



Finish the lid by fitting it over the tenon. Finish shaping the dome and sand. Put the Jacobs chuck in the tail stock to drill the hole in the lid for the finial. A 5/32" drill bit works fine, about 1/8" deep. Be careful not to go through the lid. Sand off any burs from drilling and put the lid aside.



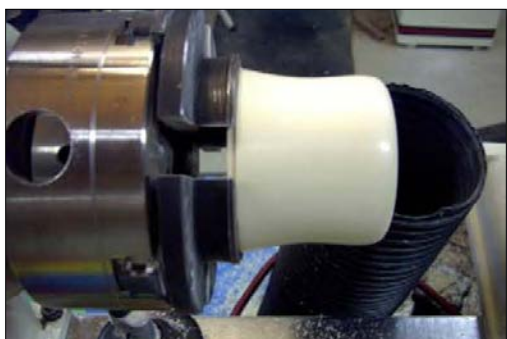
Shape the outside of the box and hollow the inside. Be sure to leave approximately 1/4" thickness in the bottom of the box finishing the outside of the bottom. Sand inside and outside. Part off box body.



Remove waste from chuck and mount the box body tenon in the chuck. Do not over-tighten or the box will crush. Make sure you can't wiggle the box by hand with minimal force.

Using very light cuts, finish shaping the bottom of the box. Make it concave so the box sits only on the outer edge. Don't use a lot of force with the tool or the box will pop out of the chuck. Add V-grooves or chatter work to dress up the bottom. Sand. Remove from chuck.

Using #1 jaws (pin jaws) in the chuck, mount the pen blank. It doesn't need to be rounded. Just be sure the jaws grip it solidly. The blank can be inserted into the chuck to reduce chatter on the end.



Turn the finial. Start at the tail stock end of the blank and make the top of

the finial. Don't make the finial too big or tall. If you put a flare at the bottom, it will better hide the hole in the lid. Be sure you leave a tenon on the head stock end of the finial to be inserted into the lid. Measure with the vernier calipers set at the drill bit size used to drill the hole in the lid.

Sand the finial and part off. If the tenon on the finial is a little too long, just touch it to the grinder to make it shorter.

Add a drop of glue to the hole in the box lid and put the finial in place. Let it dry before adding finish.

Finish the box. A few coats of Danish oil (wipe on, wait 30 minutes, wipe off) on the outside of the box works well. Walnut oil works best on the inside of the box because there are no solvents to evaporate so the inside of the box smells nice. One coat usually works fine.



Tips

- Straight-grained wood makes it much easier to match the grain between the lid and the body. Another way to best match the grain is to remove as little material between the pieces as possible, which is why I use the 1/16" parting tool and narrow kerf saw.
- Straightening the tenon can make the tenon very hot, thereby swelling the wood a little. Use compressed air to cool the wood before test-fitting the lid to get a more accurate fit.
- If the lid fits slightly loose on the box body tenon, you can wet the tenon to swell the wood fibers, which will hold the lid better... or wrap masking tape or blue painters tape around the joint to hold the lid on the box body. Don't block any areas on the lid that you need to sand.
- When reversing the box body, be very careful of the chuck jaws because they often are extended beyond the chuck body and can cause serious injury if you come into contact with them.
- The type of finish you use depends on the type of wood you select. Danish oil works very well on most domestic (US) woods. If you turn an exotic wood like cocobolo or bocote, oil finishes very often don't cure on woods with natural oils. In that case, wax or no finish at all is good.

~ Pam Riley

STUDENT PROJECT

Morse Taper

A Morse taper of wood is simple to make and is quite versatile for holding work on the lathe. One can be turned from a bit of seasoned hardwood (Maple works well) in minutes using a skew or small spindle gouge.

1. Use a Morse taper for a pattern. Mark two rings on the taper. Set a caliper to each diameter.



2. Turn a cylinder and transfer the two rings to the cylinder with a pencil line. Note: there is ample wood on the left. This will be used to form the part extending out of the lathe's spindle.



3. Part in to the two respective diameters. Make the relief cut to the smaller diameter side.



4. Form the taper by cutting a straight line from the larger diameter to the smaller diameter line. Sneak up on it by leaving it an 1/8 inch proud on each end and check with a straight edge.



5. Refine the taper. Check it with a straight edge. Remove only the high spots. Favor too large over too small. Avoid a concave!



6. Test fit and turn the taper in the lathe spindle. This will mark the high spots with dark rings unless your spindle is quite clean in which case the high spots will be shiny burnished rings.

7. Turn away the high spots and repeat this process until there are no distinct high spots.

8. Round the end of the taper. This is especially important since it will prevent the Morse taper from splitting and mushrooming when you remove it with a knockout bar.



Never put a wooden Morse taper into a self-ejecting tailstock. You may have great difficulty removing it.

Wooden Morse tapers have been in use for hundreds of years. Mark St. Leger describes making and using a wooden Morse taper in an AAW journal article “turning a whistle” 15.2 pages 18-21. They are especially useful for pin chucks or turning small pieces attached with CA glue. Wooden tapers are a lot cheaper than faceplates or chucks and hold extremely well in the headstock of most lathes.

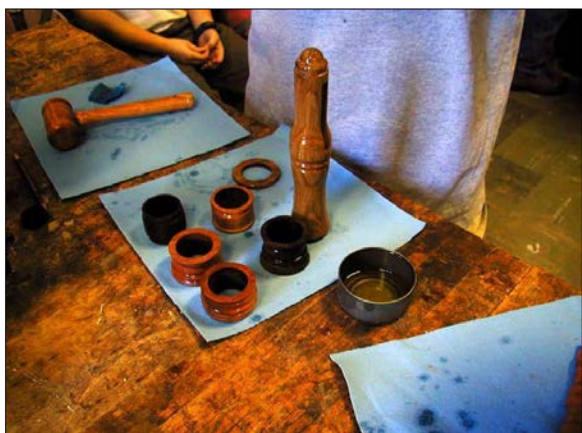
~ Al Hockenberry

STUDENT PROJECT

Napkin Rings

Napkin rings are a nice introduction to face grain turning. We have used this project with our more advanced students at Maryland Hall. We have also used it in weeklong classes with older students. The older students can turn their own mandrels. This is one project where kids will often come in the next class wanting to make a set of napkin rings. The youngest students we've done this project with were 12.

We had one student who told us he wanted to turn a set of napkin rings next week. He further explained that it took him 40 minutes to do the first one, 30 minutes to do the second one, and 15 minutes to do the third one and that next week he was going to make 8. I told him not to set out to make 8 but rather make one he was happy with and then make another. If he tried to make 8, he would, but he might not be pleased with any of them. If he concentrated on doing his best on them one at a time he might make fewer but he would be happy with them and most likely he would make more. (He made 9 nice ones.)



Pictured: Some student napkin rings wet with walnut oil. A gavel, ring, and spindle are other items done by students. The tall spindle with the slit is part of a string puzzle along with the small wooden ring.

Blank

2"x 2"x1.5" hardwood such as maple, cherry, walnut or locust with a 1.5" hole. The grain can run either way. Most often we drill the hole through the face grain. With younger students I round the square corners on their first two blanks.



Blanks, mandrels, keeper



Mandrel on a 3/4 x 16 nut and keeper

Tools

Face shield
 Disposable dust mask
 Parting tool
 1/4 or 3/8 spindle gouge
 Wooden mandrel (see below)
 Sandpaper
 Walnut oil

Design Considerations

Students can really experiment with design. The only critical element is that the smallest outside diameter must be at least 1/4" diameter larger than the hole through the middle. This may be the student's first introduction to multiples. These are multiples where a set can all have unique forms. Both symmetrical and asymmetrical forms work well. Every once in a while a student will cut through one.

Class Format

We begin each class with a review of the safety rules. I do a review of the spindle gouge. Then since this is an advanced project I demonstrate the turning of an entire napkin ring start to sanding and the students can take it from there.

Turning

1. Mount the blank on the mandrel
2. Using a high lathe speed round to a cylinder. I have students rough blanks drilled through the face grain by making light cuts from either face toward the center using a spindle gouge. A small bowl gouge could be used.



Blank on Morse taper Mandrel



Roughing the face grain blank

3. Finish turning the edge facing the head stock and reverse the blank and finish the other face. I usually have the students do this with the gouge. If they are having trouble I

have them use the parting to get a clean face.

4. Turn any design
5. Sand to 220/320
6. Remove from the mandrel and sand the hole.
7. Finish with walnut oil. Wet the napkin rings, let them sit for a few minutes and wipe off the excess.



Note: the wooden mandrels do take some abuse, better them than a chuck.

Mandrels: We don't use 4 jaw chucks in any of our youth classes. The expense aside, we don't like having young folks turning close to metal. The class lathes dictate the mandrel design. On lathes with a $\frac{3}{4}$ x16 thread I epoxy a nut into the end of a 2x 2x4 and turn the mandrel. For the 1x8 thread minis I used 2x2x 8 and turn a Morse taper on one end. The mandrel portion is made with a taper about 3" long $1 \frac{9}{16}$ " diameter tapering to $1 \frac{7}{16}$ ". Added to this is a little piece I call a keeper. It is made from a

2"x2"x 2" block with a $1 \frac{1}{2}$ " diameter hole to allow clearance from turning the napkin ring. The blank is placed over the mandrel, the keeper over the end of the mandrel and the tailstock brought up against the keeper and tightened a bit. We have had very few students who possessed both the hand strength to lock the blank onto the taper and the tool control to complete the napkin ring without the keeper.



~Al Hockenbery

STUDENT PROJECT

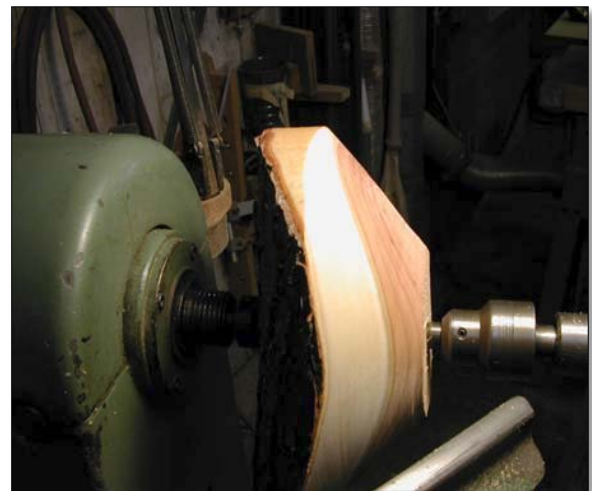
Turning a Natural Edge Bowl



Make sure your lathe is at the lowest speed setting. First, mount your blank between centers.

Use the tool rest as a reference to align the top (bark side) so that top edges of bowl will be even. This is an advantage over faceplate mount because you are able to make adjustments in alignment. Tighten tail stock and lock in place. Spin wood by hand to be sure it does not hit the tool rest before turning on the lathe.

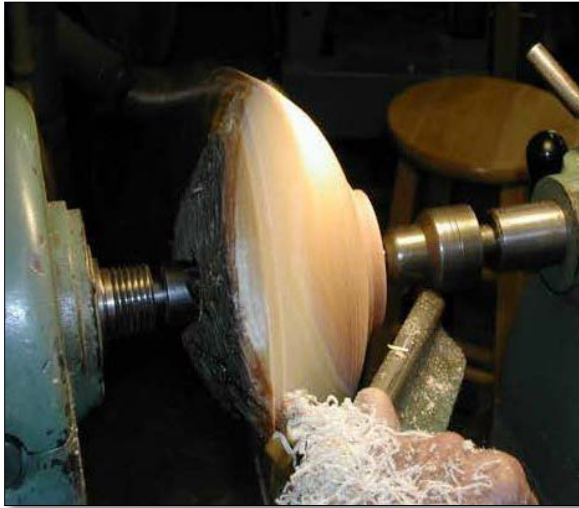
With the tool rest set at an angle, begin to shape the bowl from the bottom up using your bowl gouge. Your first objective should be to remove most of the waste wood on the bottom so you can begin to form the spigot.



Once you have formed about 2/3 of the curve, turn a spigot on the bottom that will fit in your chuck. To form the spigot, use your bowl gouge to make a cut parallel to the lathe axis and towards the head stock. Repeat until your spigot is the desired size. Turn a flat shoulder or small second spigot for the chuck jaws to rest against. Use a spindle gouge to square up the cuts by making small clean cuts from both directions. The bottom of the spigot should not quite reach the bottom of the chuck. This will allow for greater accuracy when the piece is mounted. The spigot should also have a slight dovetail shape which will fit the piece more firmly in the chuck.



Use a bowl gouge to finish shaping the outside of the bowl. Watch the top edge to see shape. Bark can be glued with CA glue if it is coming loose, especially if you will be twice turning the piece. Rough spots can be cleaned up using the sheer scraper.



Place bowl in chuck so jaws rest on shoulder (second spigot). Remove tail stock. Turn on lathe. Adjust speed if necessary. Increase speed until you begin to feel vibration and back off a little. Sheer scrape the outside to clear up any rough spots or if it is slightly out of round.

Begin Hollowing Your Bowl

Starting at the center, begin to hollow your bowl. Adjust the tool rest so the bowl gouge is cutting level and on center. Begin making small cuts toward the center of with the gouge rolled to the right at about a 45 degree angle. Start the cut straight in with the bevel remaining on the wood at all times. Continue until you are just below the wings. Do not go in and push the tool across the inside bottom of the bowl. It is essential that you stay

on the bevel during the entire cut to maintain control of the tool!
Generally, the cleanest possible cut is achieved when cutting with the grain. In the case of today's natural edge bowl and other side grain bowls you will be cutting with the grain when you are cutting from the top (bark side) towards the bottom.



Thin the wings to the desired thickness before hollowing the entire center section. This bulk in the interior is needed for support because the wood in the wings begins to flex as it becomes thin.



thinning the wings. Gradually work back from the center until wings are blended in with the sides. At this stage make sure that your body and gouge make a complete arc. Tool rest can be angled into the bowl a little for better support but make sure you spin the wood once by hand before turning the lathe on to avoid knocking off one of the fragile wings. Chatter occurs when the tool is off the tool rest too far for the size of the tool.



Now begin to remove the wood you left in the center for support while

Clean up the bottom of the bowl with a scraper if necessary. Caution: it is not advisable to scrape on the thin wings of a natural edge bowl. Raise the tool rest slightly to be sure the scraper is angled slightly downhill while still cutting on center. To remove the

bump in the center of the bottom, start cutting from below and slowly raise the scraper. Be patient! The center of the bowl is spinning very slowly compared to the outer edge. This cut takes time. On a traditional style bowl you can turn the scraper up to about a 45 degree angle so you get more of a sheer cut when scraping on the inner sides.



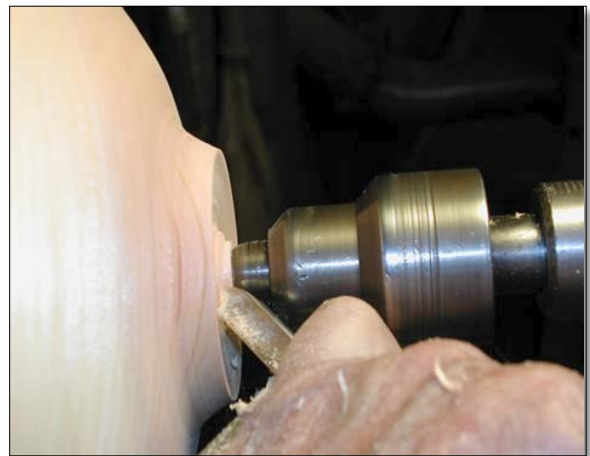
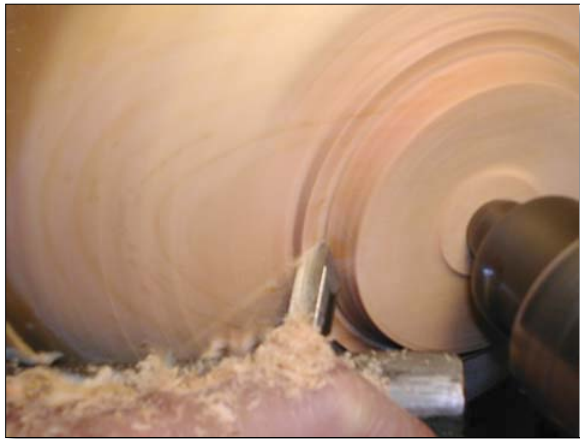
A nicely finished bottom adds class!

Remove the bowl from the chuck. Place a waste block in the chuck and secure tightly. Re-cut the waste block to shape it as needed using a spindle gouge. Use a piece of paper towel or rubber shelf liner to keep your piece from slipping in the jam chuck. Center your bowl on the waste block using the tail stock in the original center hole to press the bowl up against the waste block. Spin the bowl once by hand to make certain the wings will clear the lathe parts.



Use a spindle gouge to remove chuck marks and shape bottom as desired. Bring in the bottom by slicing in on

lower flute alternating cuts in from the side and then up from the bottom along the axis of the lathe. Make the bottom of your bowl slightly concave so that it will sit level. The thin bottom also makes your bowl less likely to crack.



Cut in along the lathe axis until only a small amount of wood remains between the tail center and the bottom of your bowl. Remove your bowl from the lathe and trim away the remaining piece in the center using a carving gouge.



The bowl in this example was turned from green (wet) wood. It does not necessarily need to be as thin as the one pictured below but it is important this it be of uniform thickness and that the pith be cut away from the bottom. Place your finished bowl in a brown paper sack (not plastic) until it is dry. Then you are ready to sand and apply the finish of your choice. If your bowl was turned from dry wood you can sand and finish it right off the lathe.

Sit back and admire your job well done!

~ Jim Burrowes

STUDENT PROJECT

Bowls

Turning a bowl is a fun project that builds essential skills for turners. The bowl is an integral part of human history. It's an object that is functional yet can be highly decorative. Within the simplicity of the form, there are still challenges to produce a well rounded profile, blended foot, and a smooth sanded finish. In woodturning, there are many variations of techniques for producing bowls, including this one. Have fun with this project.

Supplies

- Face shield
- ½" bowl gouge
- Parting tool (optional)
- Faceplate
- Four jaw chuck
- Screw jaw chuck (optional)
- Sandpaper

Process

Start the bowl with a blank 6" to 9" in diameter and 3" thick. Be careful not to start with too large a bowl while learning techniques and tool control. There are two methods of securing the wood blank for turning, use either a faceplate or screw chuck. This project was completed using the faceplate method.

If possible, use green blanks to rough out the bowls. Schedule another turning session once the blanks have been dried.





When considering grain and any spalting figure, don't put the best features at the top of the bowl. Mount your wood blank so these features are shown off in the bottom.

With the blank mounted on the lathe, place the tool rest close to the wood. Rotate the lathe BY HAND before turning, checking for clearance between the wood and tool rest.

Using a ½" bowl gouge, turn the blank round. The tailstock with a live center can be used to help steady the wood while turning it.



Shape the bottom of the bowl, concentrating on tool control and form. Include a spigot on the bottom to be held in the 4-jaw chuck for the next step. Be sure that the spigot is long enough but won't bottom out in the 4-jaw chuck. A parting tool can be used to square up the spigot.

If you're turning dry wood and are going to finish the bowl in one session, glue on a waste block. Hold the waste block in place with the tailstock until the glue dries. True up the glue block. The glue block can either have a spigot turned for a chuck or a faceplate can be attached.



Use a pen to make a small dot at the very center of the spigot. This will aid centering a bowl once it has dried.

Remove the bowl from the faceplate or screw chuck. Place the spigot in the 4-jaw chuck and tighten. The bowl should not bottom out inside the 4-jaw chuck. Turn the inside of the bowl, again practicing tool control.

Periodically check that the inside of the bowl is following the outside profile. The inside will start to deviate a little as you get into the bottom of the bowl.

If you're turning a green bowl, leave the bowl about 1" thick for drying. Place the bowl in a paper grocery bag or coat with end grain sealer. Each mentor can help decide which process is best.

For bowls turned green and dried, make a jam type chuck for truing up the spigot. Use the dot on the spigot, marked during rough out for centering the tailstock live center. The tailstock will hold the bowl to the jam chuck while truing up the spigot. Attach a glue block. For finish turning the bowl, use either a faceplate or turn a spigot on the glue block for the 4-jaw chuck.



To center a glue block on a dried bowl, turn a 3/8" small spigot on the bottom of the original spigot.

Attach your waste block to your faceplate or 4-jaw chuck and true up the face. Use a Jacobs chuck in the tail stock and drill a shallow 3/8" hole in the glue block. The glue block will now be centered when you attach it. Make sure surfaces that you're gluing together are turned flat.



Once the bowl is successfully remounted on the lathe with the rim facing away from the headstock, shape and sand the outside. Then turn the inside of the bowl to the desired thickness. Sand the inside of the bowl.

Use a parting tool to part the bowl from the glue block. Reverse the bowl and use the tailstock to hold it against the jam type chuck (from the previous step). Clean up and blend the bottom of the bowl and turn a foot if desired. Sand the bottom.

Turn the foot or bottom of the bowl slightly concave for better stability. There will be a small nub to remove from where the tailstock was holding the bowl against the jam chuck. Use a small knife or gouge to remove it and sand the area.

There are many finishes available for your bowl. Let the mentor help select a good finish for your bowl.



~ Dave Bowers

STUDENT PROJECT

Christmas Ornament Stand

Tools & Supplies

- Wood or Corian disc about $\frac{3}{4}$ " x 3" x 3" with bottom face flat and smooth
- Standard faceplate
- Double-face tape
- Ball-bearing tail center
- $\frac{3}{8}$ " spindle gouge
- Assorted abrasives
- Finish and rag (Myland sanding sealer or friction polish suggested)
- $\frac{1}{16}$ " twist drill bit
- Drill chuck
- $\frac{1}{16}$ " metal rod (brass or stainless steel)
- Scroll chuck
- Vise grips
- Needle-nose pliers



Steps

- 1. Mount blank for turning.**
Attach the faceplate to the headstock, apply double-face tape to the faceplate, center the turning blank on the faceplate, bring the tailstock into position and apply moderate pressure.
- 2. Rough turn the shape.**
Using a $\frac{3}{8}$ " spindle gouge, turn to rough shape. The tailstock should remain in position while rough turning.
- 3. Finish turning the shape.**
Remove the tailstock and turn to finish shape.
- 4. Sand and finish.**
Sand thoroughly and apply the desired finish. Most any finish will work.
- 5. Drill hole for the hanger.**
Secure a $\frac{1}{16}$ " drill bit in a drill chuck mounted in the tailstock. With the lathe turning, advance the drill bit about $\frac{1}{2}$ " into the stock.

6. Prepare the hanger.

Mount a scroll chuck in the headstock, grip about ¼" of one end of the hanger rod in the jaws of the chuck. With the lathe turned off, grip the other end of the hanger rod in vise-grip pliers, then rotate the chuck by turning the outboard hand wheel as you wrap the rod around the outside of the jaws of the chuck. Remove the rod from

the chuck, cut off the bent end using diagonal cutters, and with needle-nose pliers bend the same end 90° out from the bend of the rod. Then bend a tight loop in the other end of the rod. Press the rod into the base. The stand is now ready to hang the ornament.

~ Kip Christensen

STUDENT PROJECT

Pen

Turning pens is a good way to practice turning skills and various finishing techniques. The 7 mm pens come in many styles, such as the slim line and streamline kits. You can modify the barrel designs to create your own unique version of a pen. In this tutorial, you'll notice I am turning a pen that has a larger center, but the techniques are the same regardless of the kit. As with turning any item, remember to wear a face shield and eye protection at all times.

Supplies

- 5/8" square 5-1/2" length-This size gives you a few options and more wood to work with.
- Face shield
- 7 mm pen kit
- Pen mandrel
- Pen bushings
- Barrel trimmer
- Roughing gouge
- Spindle gouge or skew chisel
- Sandpaper (120-600 grits)
- Finishing supplies

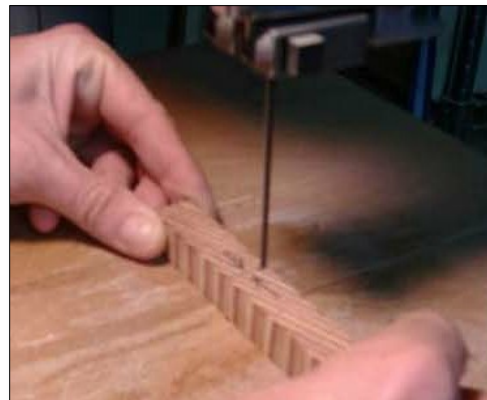
Process

Begin by drawing the cut lines on your wood blank. I use the pen tubes to do this because kits may vary slightly. Place the tubes on the blank, one at a time, and draw a line where they end.

I drew two arrows pointing to the cut line. These arrows will help later when putting the pen on the mandrel in the right directions to keep the grain matched.



Using a saw to cut the wood blank; saw the wood to the size required for the tubes.



The next step is to drill the wood with a 7mm drill bit. Use a clamping system or a drill bit vise to hold the wood securely. If possible, clamp the vise or pen clamp to the drill press for safety. If you are drilling by hand, clamp the wood blank to a counter or table while you drill. If you try to hold it and the drill bit you can hurt yourself.



With the wood blanks drilled, it's time to glue in the tubes. Spread some thin or "flexible" CA glue on the pen tube and push it quickly into the wood blank. Make sure it ends up in the blank and not sticking out of the other side. One cheap tool that works great for inserting pen tubes is a pencil. Other glues with longer drying time may be used. This might be a good break time to demonstrate the next few steps.



Let the glue dry a few minutes and then use a barrel trimmer to square the ends of the wood to the tube.



I have the pen blank clamped to the counter for safety.

Now for the turning part. Mount the pen blanks on your pen mandrel. Remember those little arrows we drew? Make sure those are pointing toward each other in the middle. The wood grain should line up. How easy was that? You should have one bushing on each end and one in the middle between the pen blanks.

Set your tool rest as close to the work as possible without hitting it. Spin the wood by hand to make sure it clears. If everything is OK, turn the lathe on. Using a roughing gouge, work the pen blanks down to small cylinders. Leaving the pen blank a bit bigger than the bushings will give you room to make decorative decisions if want. With your spindle gouge or skew chisel, turn the blanks to their final size and design. Try not to turn away any material from your bushings or you'll have to get new ones to turn your next pen.



Once you have finished turning the pen, it's time to sand it. Move the tool rest out of the way and sand from the bottom of the pen. Start with 120 grit and work your way up to 600 grit. If you notice deep sanding marks, stop the lathe and sand by hand along the length of the pen. This should get rid of them. Once the marks are gone, finish going through the grits.



When the pen is sanded, apply the finish of your choice to make it nice and shiny. Your mentor may have a few options for you to use. Some suggestions are friction polish or woodturner's wax. Explore

each of them to find your personal favorite.

On my pen, I used friction polish. To use it, stop the lathe, put a few drops of polish on a paper towel, and rub it on the pen. Turn the lathe on and lightly rub again from the bottom to I polish the finish to a high shine.



With the pen turned and finished, remove it from the mandrel and arrange the parts to be pressed into the pen blanks. A drill press is the easiest way to do this, but if you don't have access to one, you can use a hand clamp. Press the tip and the back/clip into the body first, then press the transmission in. You'll need to test the fit of the transmission and pen refill a time or two to make sure you have them right. Insert the transmission in with the brass end first. Usually pressing the transmission in to the line above the brass end will be just about right.



With the parts pressed together, insert the pen refill and then press the two halves of the body together. Twist them until the grain lines up, and you're finished.



~ Chris Wright

STUDENT PROJECT

Small Screwdriver



Tools & Supplies

- Small screwdriver shaft
- 1" x 1" x 6" hardwood
- 1/8" twist drill
- Lathe with scroll chuck
- Drill chuck
- Drill press with drill press vise
- Drive mandrel
- Small spacer
- Ball bearing tail center
- Spindle roughing gouge
- Shallow spindle gouge
- 3/8" spindle gouge
- Assorted abrasives
- Skew
- Wire burner
- Finish and rag
- CA glue or epoxy

1. Prepare the screwdriver shaft.

This project requires having a small unhandled screwdriver shaft to be inserted into a turned handle. Screwdriver shafts can be purchased online or can be removed from plastic screwdrivers by breaking off the handle.

2. Prepare wood handle blank.

Prepare a piece of straight grained hardwood about 1" square and 6" long. In one end of the wood, drill a 1/8" hole (or equal to the diameter of the screwdriver shaft) and about 1-1/2" deep. This can be done on the lathe but is quicker to do on the drill press.

3. Mount the blank for turning.

Secure in a drill chuck held in the headstock a drive mandrel that fits the diameter of the drilled hole. This can be the drill bit used to drill the hole or a metal mandrel of equal diameter. It is best if the fit is fairly snug. If desired, use a plastic spacer about 1/2" long and 1/4" in diameter as a buffer between the drill chuck and the turning blank. Put the turning blank over the mandrel, bring the tailstock into position, and provide moderate pressure.

4. Rough turn the handle.

Remove the square corners and turn to rough shape. A relatively high RPM is recommended (approx. 2,500-3,000).

5. Finish turn the handle.

Turn the handle to final shape, including detail cuts. Leave the wood near the tail center about ¼" diameter.

6. Sand.

Sand thoroughly. The final sanding should be done parallel to the grain while the lathe is stopped.

7. Apply wire burn decoration.

If desired, apply wired burn lines by using a skew to scrape very small vee grooves on the surface of the wood and then holding the wire burner in each groove to create a friction burn. Lightly sand the surface around the burned areas with fine abrasive to remove any burn residue. Do not touch the hot wire.

8. Apply the finish.

Apply the desired finish. Most oil finishes work well.

9. Remove the handle from lathe and clean the end.

Carefully turn the wood near the tail center to a small diameter. Remove the handle from the lathe, trim and sand the excess wood, and apply finish to the end.

10. Glue the screwdriver into the handle.

Pour a drop of thick CA glue (or epoxy) into the hole in the turned handle and drive the screwdriver shaft into the hole with a wooden mallet. Allow the adhesive to set before using the screwdriver.

~ Kip Christensen

STUDENT PROJECT

Spheres

Spheres are simple to turn and lots of fun. There are many ways to turn them. The system described here works for me, but your local mentors may have tips and tricks that work just as well. The system of cutting three grooves is one that I learned from Stuart Batty who learned it from his father, Allan Batty, who learned it from the ancient Greeks. It is a system that was used to turn cue balls from ivory. For me, it is quite simple and takes a bit of the mystery out of “chasing the illusive ghost.” Spheres can be turned in all sizes and from any kind of wood you choose. The sphere in these photos is about 4” in diameter and turned from dry ambrosia maple. You may use green wood if you wish, but know that it may crack as it dries and most certainly will change shape.

Begin with a piece of square stock that is slightly longer than it is square. Locate and mark the center on each end.



Mount the blank between two centers. I prefer using the OneWay safe center in the head stock end, but if you have only that standard spur drive center that came with your lathe, that may be used. For the tail stock side, use whatever live center came with your lathe.



Turn the rectangular blank down to a cylinder using a roughing gouge.



Locate the center and mark it with a pencil.



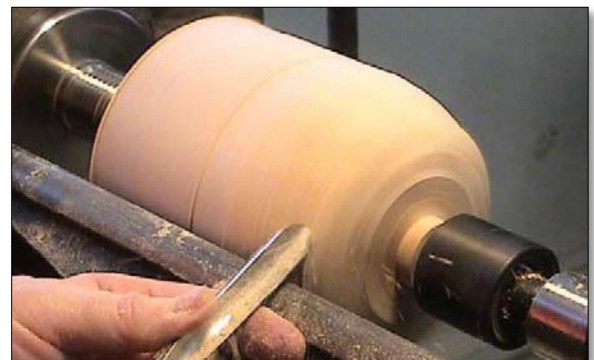
Square the ends and trim until the length and diameter are equal. The parting tool or bedan is excellent for this.



Use a parting tool to cut a slight groove on the center line.

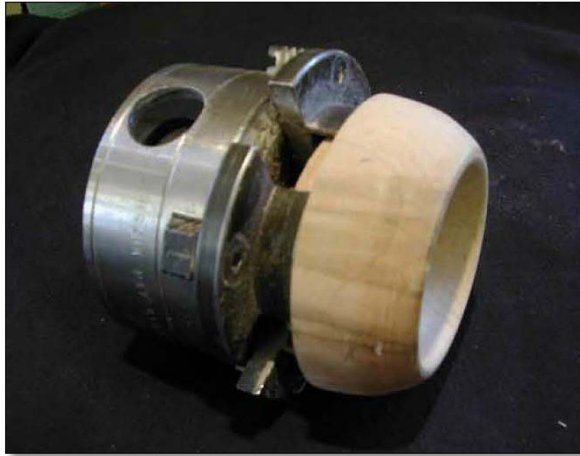


Use a detail or spindle gouge to begin rounding, starting at the corner. Be careful not to cut away the center groove or take away too much wood at the top of the curve.



To re-chuck the sphere, you will need to turn some sort of cup centers. There are several ways to do this. The cup on the headstock end can be turned on a faceplate, a screw center, or cut with a spigot or groove to mount in a chuck. It also is possible to turn a cup center with its own No. 2 Morse taper stem that will fit directly into the headstock.

Al Hockenbery has instructions for this type of cup chuck in another lesson.



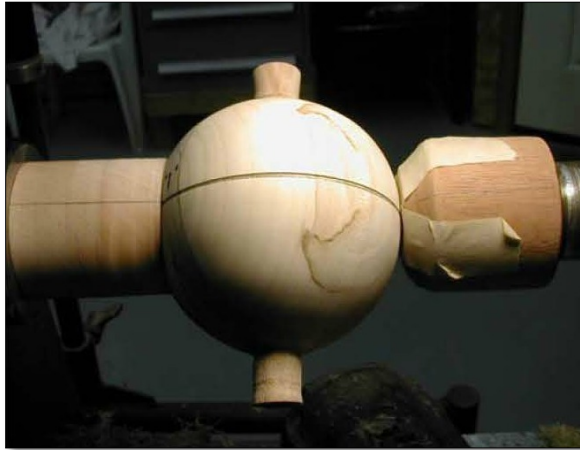
The size of the cup will depend upon the size of the sphere you wish to turn.



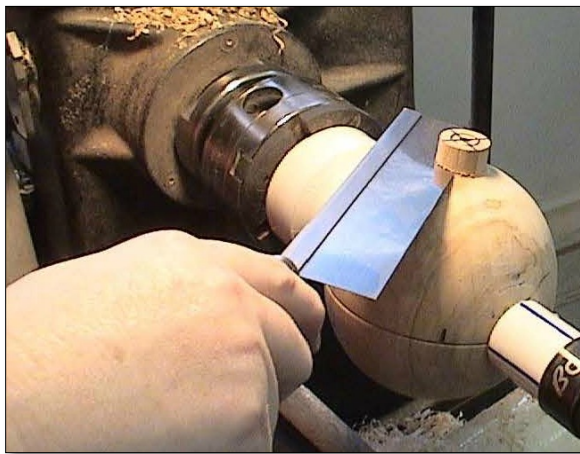
For the tailstock side, there are several options as well. If you have a live center with a removable point, you can turn a cup center with a stem that will fit into the center hole once the point is removed.

Re-chuck your sphere between the two cup centers. Make sure that the 1st groove is now aligned with the lathe's center axis and is parallel to the lathe bed.

If you do not have a live center with a removable point, you will need to turn a cup on a block that is drilled or hollowed to fit over your live center.



The easiest way to remove the “ears” is with a small hand saw.



Locate the center and cut a second groove perpendicular to your first groove. This second groove must be to the exact depth as the first one without cutting any deeper. Watch the shadow along the top edge of the sphere. Turn away any material that does not appear solid down to but not beyond the first two grooves.



Rotate the sphere one more time to create the third groove. Do this by turning the sphere 90° to the right and keeping the first groove on the center axis. Make sure that the third groove does not extend deeper than the previous two.



Continue to turn away excess wood until you have cut evenly and smoothly down to the three grooves without removing your original lines.

Repeat the three rotations if necessary to perfect the shape. Keep your eye on the top edge of the sphere and trim away all wood that does not appear to be solid. It may help to lay a piece of dark fabric or paper behind your lathe so you can see the shape more clearly. A good light is essential.

Finally, rotate one last time to sand through whatever grits you wish. You might want to place a piece of rubber shelf paper or some masking tape on the centers when making your finish cuts and sanding to prevent marks from the cups on your finished sphere.



~ Barbara Crockett

STUDENT PROJECT

Turned Top

Turning tops is a great way to introduce youth to turning. It's a project that starts laying the foundation of turning while providing immediate results. The top project is fun and, as the students become more proficient, you can vary the designs and decorations to keep it interesting. Provide brightly colored markers and let the student be expressive.



Wood Blank

- 2" x 2" x 5" maple blank. Other woods may be used but consider woods that have tight grain.

Tools

- Faceshield
- 1/2" Spindle gouge
- Skew
- Chatter tool (optional)
- Four jaw chuck
- Face plate with glue block (optional)
- Colored markers
- Sandpaper

Begin by making tops, starting with 2" x 2" x 5" maple blanks.



Remember to always rub the bevel and cut downhill when turning spindle projects. Mount the blank in the 4-jaw chuck. Then, using your 1/2" spindle gouge, round the blank down to a cylinder. Be careful that you don't try to round the blank too close to the chuck jaws.



If 4-jaw chucks are not available, face plates with or without glue blocks can be used. If a glue block is used, shorten your blank accordingly.



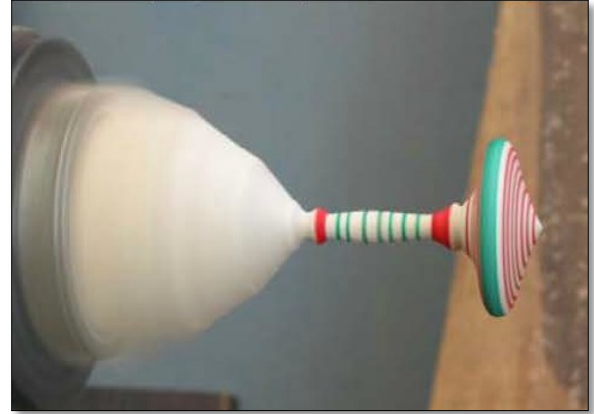
Once the cylinder is formed, begin shaping the end (the tailstock side) to form the bottom. Keep the bottom gentle and smooth, always rubbing the bevels as you cut. Once this is finished, color and use the chatter tools as desired for decoration of the bottom. Now it's time to start shaping the handle and define the top portion of the disk.



Finish forming the handle and disc. There is great design opportunity at this point for the shape of the handle, forming small beads and coves if desired. Turn the handle down to approximately 1/4" blending the handle with the disc. Maintaining a sharp tool and rubbing the bevel will help eliminate sanding.



Any type of marker can be used. You'll find them at art supply stores, craft stores, or any store that sells school supplies. Have a variety of bright colors for decoration.



Complete your coloring of the top. When you are finished coloring, slow the lathe and part off the top with a skew, toe side down. Cradle the top with the other hand to catch it while parting off. The mentor should help with this process.

Lightly sand the handle top, if required, with 220 grit to smooth it out. You're done with the top – Enjoy!

~ Dave Bowers

STUDENT PROJECT

Weed Pots

Weed pots are a great way to utilize spindle-turning techniques, and they are a great project to give as gifts to relatives and friends. Any size blank will do, but this project is particularly suited for those cut-offs that are not going to be used for other projects.

Tools

- Roughing gouge
- 3/8" Spindle gouge
- Parting tool
- 4-jaw chuck
- Jacobs chuck with Morse taper
- 3/8" drill bit
- Sandpaper



Begin with a 2-1/2" square b 6" wood blank. Start the blank between centers (live center in the tail stock). Position the tool rest close to the work piece, rotating the wood by hand to check for clearance.

Turn the stock down to a cylinder. There are many different design ideas to explore, so discuss them with the mentor.



Turn a tenon on one end to seat in the 4-jaw chuck. Make sure that the tenon won't bottom out in that chuck. While the piece is between centers, rough out the shape of your weed pot. Although this picture illustrates the base of the weed pot being roughed out on the tail stock end, it doesn't matter while between centers. Work with the student and see which orientation will work for them.



If a 4-jaw chuck is not available, this project can be completed with a face plate. Make sure longer screws are used for end grain and adjustments are made to either the design or blank length. Set the weed pots tenon in the 4-jaw chuck. Turn the top of the weed pot in just a bit.



Place the Jacobs chuck in the tail stock. Using the 3/8" drill bit, drill a hole as deep as you can. Blend the top with the hole.

Replace the live center back into the tail stock. Bring the center into the hole for support and finish turn the weed pot's shape. Work the base down and sand the entire piece.



Use a parting tool to part the base. Install the Jacobs chuck into the headstock with the 3/8" drill bit. Slide the weed pot hole over the drill bit and bring the tail stock securely to the base. Finish turning and blending the bottom, turning a slightly concave surface. The concave surface gives the weed pot stability when standing up. Sand the base then remove from the drill bit. Trim and sand any nub of wood left from the tailstock.



~ Dave Bowers

STUDENT PROJECT

Handle for Whisk



AAW
EDUCATION

Tools & Supplies

- Small kitchen whisk
- Pliers
- 1"x1"x6" hardwood
- 15/64" twist drill
- Lathe with scroll chuck & drill chuck, or with drill press & drill press vise
- Drill chuck
- Dive mandrel (optional: can use drill bit)
- Small spacer
- Ball-bearing tail center
- Spindle roughing gouge
- Shallow spindle gouge
- 3/8" spindle gouge
- Assorted abrasives
- Skew
- Wire burner
- Finish & rag
- CA glue or epoxy

Steps

1. Prepare the whisk.

This project requires that you have a small unhandled kitchen whisk to be inserted into a turned handle. Kitchen whisks can be purchased from kitchen stores or online. The cost of a small whisk is usually a dollar or less.

To prepare the whisk, you will probably need to use a pair of pliers to slightly bend the loop on the handle end of the whisk so it is not wider than the diameter of the handle section of the whisk.

2. Prepare the wood handle blank.

Prepare a piece of straight grained hardwood about 1" square and 6" long. In one end of the wood, drill a hole equal to the diameter of the handle portion of the whisk and deep enough to insert all but ½" of the length of the whisk handle. This can be done on the lathe but is quicker to do on the drill press.

3. Mount the blank for turning.

Secure in a drill chuck held in the headstock a drive mandrel that fits the diameter of the drilled hole. This can be the drill bit used to drill the hole, a metal mandrel, or a turned wood mandrel. It is best if the fit is fairly snug. If desired, use a plastic spacer about 1/2" long and 1/4" in diameter as a buffer between the drill chuck and the turning blank. Put the turning blank over the mandrel, bring the tailstock into position, and provide moderate pressure.

4. Rough turn the handle.

Remove the square corners and turn to rough shape. A relatively high RPM is recommended (approx. 2,500-3,000).

5. Finish turn the handle.

Turn the handle to final shape including detail cuts. Leave the wood near the tail center about ¼" diameter.

6. Sand.

Sand thoroughly. The final sanding should be done parallel to the grain while the lathe is stopped.

7. Apply wire burn decoration.

If desired, apply wire burn lines by using a skew to scrape very small vee grooves on the surface of the wood and then holding the wire burner in each groove to create a friction burn. Lightly sand the burned areas with fine abrasive to remove any burn residue. Do not touch the hot wire.

8. Apply the finish.

Apply the desired finish. Most any oil finishes work well.

9. Remove the handle from lathe and clean the end.

Carefully turn the wood near the tail center to a smaller diameter. Remove the handle from the lathe, trim and sand the excess wood, and apply finish to the end.

10. Glue the whisk into the handle.

Pour a few drops of thick CA glue (or epoxy) into the hole in the turned handle and slowly push the whisk into the hole. Prop the assembled whisk in a vertical position long enough for the glue to set.

~ Kip Christensen