

This is a low-resolution printable version of the teacher-presentation information. The original PowerPoint slides are clearer and animated to assist the teacher in delivering quality content to the students.

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Licensed users of the EST Foundations curriculum have access to:

- the original animated PowerPoint files
- accompanying handouts
- detailed homework assignments
- lesson plans including online reading and research assignments, and
- suggestions on integrating this project-based curriculum.

Topic 4 (ver 1.0) **Basic Project Skills-Production/Safety**
Content of this module

- Bell work 4.1
- Use slides to discuss various shop tools
- Bell work 4.2
- Discuss four general safety guidelines
- Discuss specific shop safety rules
- Complete safety worksheet from information on slides
- Bell work 4.3
- Take written shop safety test
- Prepare for safety-tool practical
- Bell work 4.4
- Overview industrial manufacturing processes
- Prepare for safety-tool practical
- Bell work 4.5
- Complete safety-tool practical

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4.1 Basic Tool Descriptions

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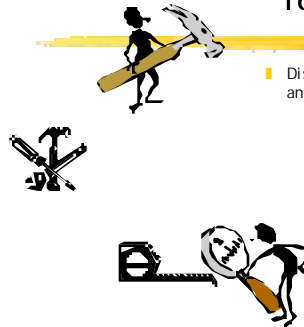
Bell Work 4.1

- Review the handout listing the tools that are available in this class. By each tool indicate how familiar with the tool you are by writing one of the following:
 - No idea (indicating you have no idea what the tool is)
 - Seen it used (indicating you have seen it used, but haven't used it yourself)
 - Used it (indicating you have personally used it at least once)

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Today's Agenda

- Discuss various shop tools, their use and their features



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Basic Tool Descriptions: Drill



Note: Keyless chuck
(next slide shows a keyed chuck)

- Drilling refers to the basic operation of boring a hole in a work piece...usually by rotating an abrasive bit in contact with the work piece.
- The tool that supplies the spinning torque is the "drill". The tool that is being spun and makes contact with the work piece to remove material is called the "bit".
- There are other operations that use spinning tools including shaping, routing, and sanding.
- There are drilling operations that do not require a spinning bit.

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Basic Tool Descriptions: Drill Press

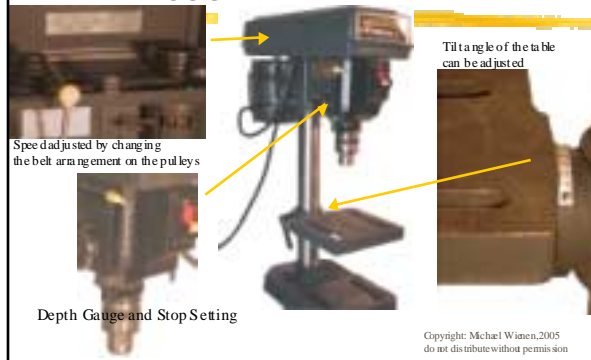


Note: Keyed chuck to grip the bit

- A Drill Press is simple a drill motor that is installed in an upright position.
- This configuration allows the operator more precise control of the angle and depth of the hole formation.
- Typically the speed is varied by adjusting the belt drive system and the speed is not variable during operation.

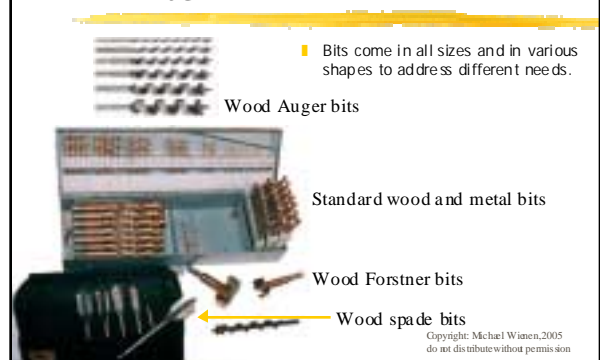
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Basic Tool Descriptions: Drill Press



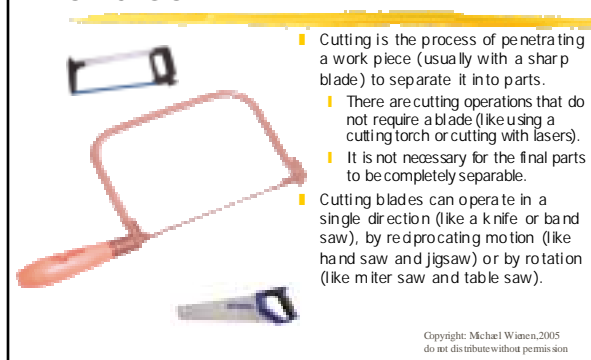
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Basic Tool Descriptions: Drill Bits



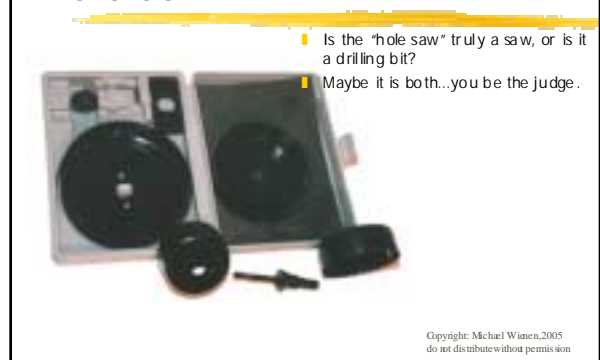
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Basic Tool Descriptions: Hand Saw



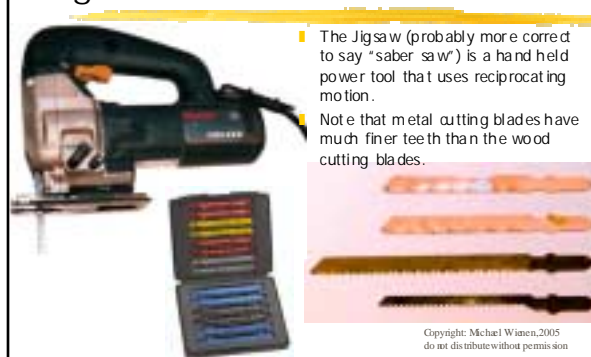
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Basic Tool Descriptions: Hole Saw



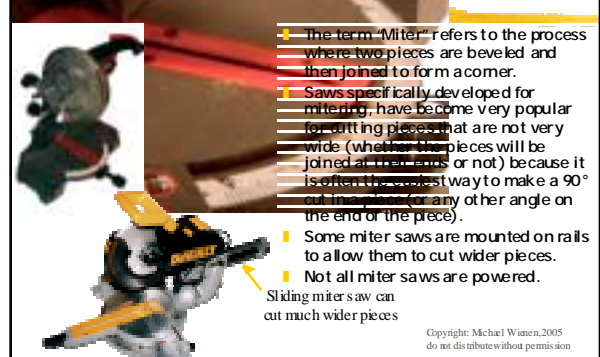
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Basic Tool Descriptions: Jigsaw



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Basic Tool Descriptions: Miter Saw



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Power Scroll Saw



Work piece guide
Table tilt adjustment
Variable speed control

- The power scroll saw uses a fine blade attached to a long arm oscillating arm.
- The variable speed control, table tilt, and work-piece guide allows extremely precise control.
- Many users are lulled into lowering their safety awareness while using this tool because it appears harmless. You must remember to respect the tool and take all safety precautions.
- Remember to use appropriate blades for metal and wood working.

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Basic Tool Descriptions: Pliers



- Pliers are tools that have two pivoting jaws designed for holding, bending, or cutting.
- Pliers use mechanical advantage to apply extreme pressure to the work piece.
- Using the wrong pliers for the job doesn't often damage the tool but often damages the work piece and is almost certain to frustrate the user.

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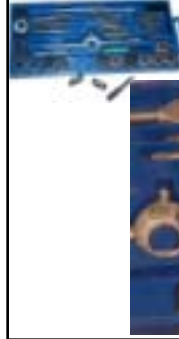
Basic Tool Descriptions: Screw Drivers



- The term "Screw" refers to any cylindrical fastener that utilizes spiral advancing threads to penetrate and hold fast to the work piece. (A "bolt" is similar but requires a mating "nut" to secure it.)
- There are an infinite variety of screws. They vary in material, diameter, length, threads, and the type of head.
- When choosing a fastener for a design, consider: self tapping thread versus machine thread, screw diameter, and number of threads per inch.
- The appropriate driver should be chosen for the specific screw to avoid damage to the screw and the driver.

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Basic Tool Descriptions: Tap and Die



- Ever wonder how threads are put on metal rods to make bolts or put into a work piece so that a machine screw can be installed in the hole?
- A "Tap" is a tool used to cut threads into an existing hole.
- A "Die" is used to cut threads onto a rod.
- Both operations require extreme pressure when dealing with metal work pieces. It is VERY important that you begin with precisely the correct hole size or rod size. (Tables can be found online but probably came with your tap & die set.)
- Use of "cutting fluid" will help.

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Basic Tool Descriptions: Files and Sanding Tools

Orbital Sander

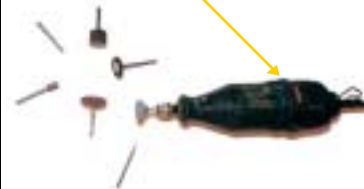


- Removing sharp edges from both wood and metal work pieces is very important.
- Splinters and cuts (especially from metal work pieces) can be very dangerous.
- Do not rely on others to be careful when handling a piece that you made... just finish your job and make it safe to handle.

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Basic Tool Descriptions: Rotary Tool

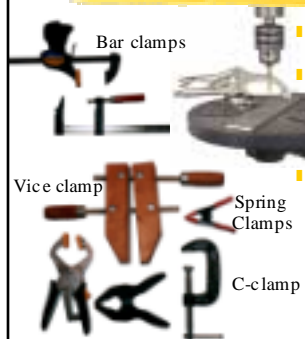
Speed Control
(this one goes up to 30,000 rpm)



- Rotary tools offer hobbyists a wide variety of operations for small projects.
- There are dozens of available bits:
 - for cutting (metal or wood)
 - for sanding
 - filing
 - chiseling
 - polishing...

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Basic Tool Descriptions: Clamps



Bar clamps

Vice clamp

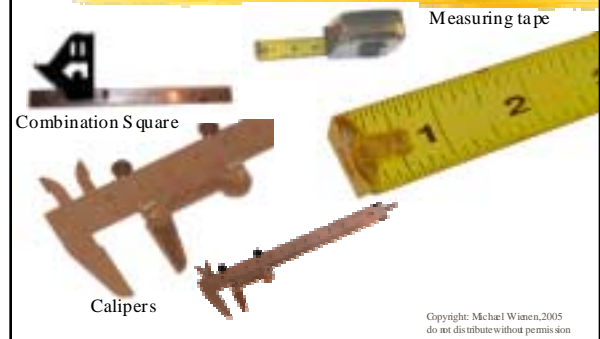
Spring Clamps

C-clamp

- Clamps are used to grip, support, compress, or join mechanical parts.
- In the shop they are invaluable tools to maximize safety and minimize frustration...they firmly hold a work piece in place to free up the worker's hands for other responsibilities.
- Usually, it is best to clamp the work piece even if you don't think it will be necessary...just in case something unexpected occurs that would otherwise cause sudden movement by the work piece.

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Basic Tool Descriptions: Measuring Devices




Measuring tape

Combination Square

Calipers

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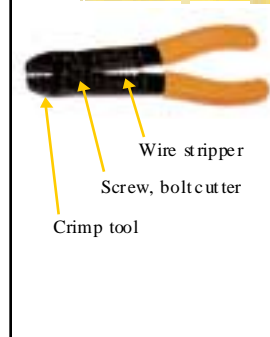
Basic Tool Descriptions: Soldering Iron



- Soldering is the process of fusing metal parts with a low melting-temperature alloy usually with the intent of providing good electrical connection.
- To solder, the parts that you wish to join are heated with the soldering iron or soldering gun. Special material called "solder" is brought into contact with the heated parts. The solder melts and flows onto the parts and is allowed to cool.
- Solder is meant to be an electrical connection, not a mechanical weld.

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Wire Stripper, Crimp Tool and Screw Cutter



Wire stripper

Screw, bolt cutter

Crimp tool

- This multi-purpose set of pliers is very helpful when wiring.
- The wire stripping tool is gauged for common wire sizes. Be sure to use the correct size slot for the wire, or you'll wind up damaging the wire.
- The crimp tool assists in attaching "crimp" connectors to the stripped wire.
- The screw cutter consists of a series of threaded holes. If you thread a machine screw into the proper hole, you can use the pliers to cut the screw to the proper length.

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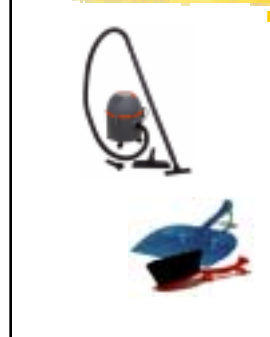
Basic Tool Descriptions: Safety Equipment



- The most effective safety tool is education.
- Unpredictable events WILL occur in the shop. All workers and observers should use eye protection and hearing protection when warranted.
- All workers should know how to respond to medical emergencies and where to find the first aid kit.
- All workers should know the protocol to respond to fires and where to find related equipment.

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Basic Tool Descriptions: Safety Equipment-con't



- Three pieces of equipment that are often forgotten effect the safety of a workplace. They are:
 - Dust Collection System** removes saw dust as the tool is operating. Without one, operators should use a dust mask.
 - A **"Shop Vac"** is a special vacuum to remove dust and debris from the shop area. It is important to remove saw dust from smooth floors...it is a slipping hazard. It is also important to vacuum metal shavings soon so that the next person doesn't get hurt by them.
 - It is very bad practice to sweep cuttings (metal or wood) away from the work piece and work area using your hand or by blowing them. A small **hand brush** should be used instead.

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4.2 Shop Safety

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Bell Work 4.2

- In your journal...
- (In 20-30 words) Is paper dangerous? Explain.

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Today's Agenda



- Discuss four general safety guidelines
- Discuss specific shop safety rules
- Individually work on shop safety worksheet (from information on slides and handouts)

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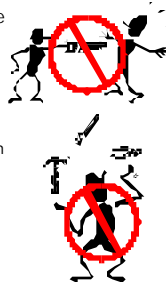
Work to Prevent Accidents

- It is difficult to protect yourself from every possible accident...because you can't focus your attention on everything all the time.
- But it is VERY easy to minimize the chance of being hurt while using tools.
- Just know the safety rules and focus on what you are doing...

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General Safety Guideline 1

- Never horse around while you or anyone nearby is working with tools.
- Most tools are harder than human skin and bones...and they often have sharp edges. It is simple, when soft material meets hard-sharp material...the soft material loses.
- Horsing around increases the likelihood of an accident (throwing tools, juggling tools, sword fighting with tools, pretending to cut/hit someone, pushing people near tools, are all very bad ideas).



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General Safety Guideline 2

- If there is any chance whatsoever of fragments from the work piece or the tool flying off, then the worker and all observers need to wear approved safety glasses.
- The eye is incredibly delicate and you don't have any to spare.



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General Safety Guideline 3

- If you don't know the right/safe way to use a tool...then don't use it.
 - Each student will have to be "certified" before using a tool.
 - That specific training will come soon.



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General Safety Guideline 4

- Use the right tool for the job.
 - Using the wrong tool usually leads to relying on excessive force and an unbalanced worker. The user is just plain lucky if everything goes well. Gambling with yours and other's safety is not acceptable.



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Note to Teacher

- **Teacher: The following two slides should be replaced with safety rules and procedures that are sanctioned and approved by your school district. It is important that all students pass a safety assessment that is approved by your school district before being in an area where tools are being used.**
- **Also, make sure to secure parental consent.**

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General Shop Rules (part 1)

- Every person that enters the tool/construction area:
 - must be tool and safety certified by the instructor or must be accompanied by the instructor and,
 - must be familiar with the emergency procedures.
- Traffic around the construction area is restricted to essential personnel only. If you are not actively working on a project or actively preparing for a future one, then get out.
- Strict cleanup policies will be enforced to minimize distractions and tripping hazards.
- Ear protection is not optional. Every person that is in the work area must wear hearing protection when power tools are in use or when hammering is in process.
- Make sure you know where the start and stop buttons are for any machine that you are working near.
- Always use the proper tool (and proper bit) for the job. If you are not sure, then ask the instructor.
- Do not wear loose clothing, work gloves, neckties, rings, broodets, or other jewelry that can become entangled with moving parts. Long hair MUST be kept in a bun (not a ponytail) when using power tools.

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General Shop Rules (part 2)

- All persons in the immediate vicinity must wear safety glasses when anyone is drilling, cutting, hammering, or operating any other power tool.
- Dust masks must be worn when sanding.
- Clamps must be used when drilling or cutting. Never rely on someone else to hold the work piece steady.
- Any safety guards that come with the tool must be properly used.
- Unplug power tools as soon as you have finished using them. Do not leave the station (even for one second) without first unplugging the tool.
- Immediately return any tool you were using to its proper place before you leave your work station.
- Ensure that the immediate work area is free of clutter, distractions, and hazards before plugging the tool in.
- Before starting any tool verbally announce to everyone in the shop "ready to cut" and allow time for anyone to object before you commence.

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Things you should consider every time you begin work

- Woodworking/metalworking tools can be dangerous if not used properly.
- If you don't know how to safely inspect a tool for damage, then don't use it. Never use an obviously damaged tool.
- Make sure you understand instructions before attempting to use any tool or machine. Ask questions if you have any doubts about doing the work safely.
- Read the owner's manual carefully.
- The key to power tool safety is FEAR! Always be RESPECTFUL (afraid) of that tool and what it COULD do if that really remote possibility happened.
- Do not let yourself get distracted from the work. Eliminate possible distractions before you begin working with a tool. If someone is being a distraction is it your responsibility to ask the instructor to have them leave the area.

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Things you should always avoid when woodworking/metalworking

- Avoid loose clothing, unrestrained long hair, work gloves, neckties, rings, bracelets, or other jewelry that can become entangled with moving parts. In a nose cord, clothing or hair caught caught in a tool and suck the operator into the path of the tool. Serious injury is almost guaranteed to follow. Long hair MUST be kept in a bun when using power tools. Do NOT rely on a ponytail to keep hair out of any power tool.
- Avoid awkward operations and hand positions where a sudden slip could cause your hand to move into the cutting tool or blade. Never place a body part in the path of a tool and never push directly towards a working tool. If the tool slips, you don't want it to head suddenly towards you. If your hand should slip, you don't want it to move suddenly into the tool.
- Do not remove sawdust or cuttings from the cutting head by hand while a machine is running. Use a stick or brush when the machine has stopped moving.
- Do not use compressed air to remove sawdust, turnings, etc., from machines or clothing.
- Do not leave machines running unattended (unless they are designed and intended to be operated while unattended). Do not leave a machine until the power is turned off and the machine comes to a complete stop. Be sure to avoid injury when the tool is powered off but still in motion. Saws, drills, and similar tools can still wreak a lot of havoc if you encounter their unpowered but still spinning moving parts.
- Do not try to free a stalled blade before turning the power off.
- Do not distract or startle an operator while he or she is using woodworking equipment.

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4.3 Written Safety Test

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Bell Work 4.3

- Study the General Safety Guidelines, General Shop Rules, and the lists of things you should consider and avoid while woodworking or metal working.
- Be ready for a written test when the Bell sounds.

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Today's Agenda



- Take written shop safety test
- Independently read tool documentation to prepare for tool/safety practical on Friday
- Discuss practical features of tools when everyone is finished with the written shop safety test

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4.4 Common Manufacturing Processes

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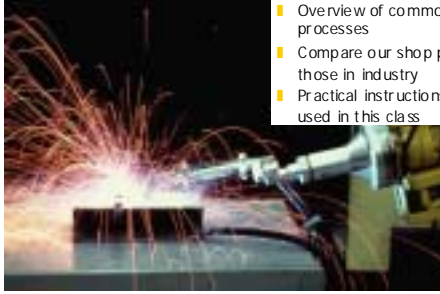
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Bell Work 4.4

- Individually look up answers to questions that you missed on the written safety test. Neatly write the correct answer in the margin next to the question.

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Today's Agenda



- Overview of common industrial processes
- Compare our shop processes to those in industry
- Practical instructions about the tools used in this class

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Common Industrial Processes

Cold Forming Processes	Hot Forming Processes	Machining	Sheet Metal Processes
Cold Rolling	Die Casting	Drilling	Laser Cutting
Staking	Sand Casting	Routing	CNC Fabrication
Brazing	Extrusion	Turning	Bending
Impact Extrusion	Forging	Milling	Stamping (Blanking, Drawing, Piercing)
	Powder Metallurgy	Grinding	Welding
		Chip Formation	

Heat Treatments	Surface Treatments	Rapid Prototyping
Annealing	Electroplating	Stereolithography
Tempering	Electroless Plating	Laser Sintering
Direct Hardening	Conversion Coating	Fixed Deposition
Selective Hardening	Thin-Film Coating	Solid Ground Clirring
Diffusion Hardening	Thermal Spraying	Ink Jet
Stress Relieving	High Energy Treatments	Rapid Tooling

- The handout to accompany this slide which briefly describes each process has not yet been developed...this might be a good opportunity to do independent online research.

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Hands on Tool Demonstrations

- Teacher: Arrange all the tools around the room.
 - Using actual tools as visual aids verbally describe each of the tools available for the class to use.
 - After describing all the tools allow the students to randomly visit every station and interact with the **Unplugged** tools.
 - You may want to modify the practical worksheet and have them answer similar questions regarding each tool.
 - Use the slides from 4.1 as a guide.

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4.5 Safety Practical

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Bell Work 4.5

- Study notes and handouts to prepare for the safety-tool practical exam.

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Today's Agenda

- Individually complete the practical shop tool-safety handout by visiting each station and recording your answer to the question.
- Teacher: plan practical questions to take equal time at each station. One student per station. Change stations every 2 minutes.

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