GUIDE FOR LASERS IN EDUCATION

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IS IT TIME TO ADD A LASER TO YOUR SCHOOL?

From smart boards to tablets, 3D printers to laser cutters, more and more schools are bringing hands-on, interactive technology to the classroom. Whether it is an industrial technology course, art lab, or a makerspace, schools and universities incorporating new technology in the classroom are engaging more students and creating active learners.

Laser cutting/engraving systems are fast becoming one of the most in-demand tools to add to the classroom, or in some cases, build an entire curriculum around. Laser cutters are versatile, easy to use, and safe. Not to mention incredibly fun to use.

But is a laser engraving system right for your school? Are you prepared for the many decisions that must be examined before you purchase a laser engraving system?

This guide will give you a head start in answering many of the fundamental questions you must consider before purchasing a laser. The purpose of this guide is not to provide you a full curriculum, but rather to get you started on designing the curriculum that is ideal for your particular program.

Are we completely unbiased? Of course not - we want you to add an Epilog to your school! But what we will promise is that we're providing you with a great look at what is involved in making your decision. If you decide an Epilog Laser system is right for you, great! If not, we want you to be as informed as possible as you make your ultimate choice.

Take a look through this guide and decide for yourself if a laser cutting/engraving system is right for your school. Create a list of questions that you don't find in the booklet and set up a demonstration with the Epilog Laser representative in your area. They'll be able to address any addition questions you may have and you can see for yourself how beneficial adding a laser to your classroom can be!

LASERS IN EDUCATIONAL CURRICULUM

There are two main categories in which we see educational facilities adding laser technology: specific classes for tailored applications, and makerspaces. First we'll take a look at different types of courses using lasers.

From industrial shop classes to art to architectural design, schools are discovering what a powerful tool a laser can be in engaging, inspiring, and educating students. Lasers in the classroom can build critical thinking and problem solving skills, foster creativity, encourage peer collaboration, and create more engaged and successful teachers.

Classrooms Can Benefit from a Laser

Lasers are incredibly versatile, and can be incorporated into a variety of courses. We also find that lasers are exceptionally popular in schools outside the classroom setting, as they can also be used for creating student or teacher awards, cutting classroom signage in-house, creating promotional products for school fundraisers, etc.)

Depending on the class subject and curriculum, we've seen lasers used in all kinds of courses including:

- Woodshop/Woodworking
- Industrial arts
- Fashion courses & labs (for cutting patterns and fabric, and other substrates to create accessories such as pendants and earrings.)
- Technology classes
- Art/design/photography courses
- STEM-focused courses

EDUCATIONAL MAKERSPACES

What is a makerspace? It's a space that is designed for your students to access technology products that they can use to learn and create. Some makers spaces are just starting out and will have a supply of electronics for students to use to tinker with. Others are more advanced and established, offering students access to CNC routers, 3D printers, welding equipment, laser cutters (and more!). Each offer students a great resource to further their creativity.

School Makerspace Benefits

• Taking Products from Ideas to Reality
Technology has taken on a new importance in the classroom. By incorporating interactive technology resources, you are able to take student's ideas from concept to creation to completion. Every student has the potential to be a maker. Imagine your design students tackling a product packaging assignment by laser cutting real-world materials and creating a finished prototype. Or a woodworking project where students use the laser to create custom marquetry work on a table they built themselves.

• Resource Expectations
With many high schools incorporating advanced laser technology in the classroom, many university-bound students are already accustomed to - and expecting - this type of equipment to be available during their undergraduate experience. Does your school match up to the expectations of these students? The university a student selects to attend can increasingly come down to the speciality resources they offer.

• The Spaces Help Students Prepare for the Future
Since it is an integral part of how we work and live, enabling students to use technology to learn, research, collaborate, and solve problems from an early age better prepares them for their careers. It helps reduce fears of adopting new technology in the future by familiarizing students with the discovery process for each new tool.

Makerspaces also foster the entrepreneurship spirit in a very real way. Having tools within their reach that allow students to take their ideas to production lets them see how they could take their unique ideas and start a business with a few simple tools.

What Equipment Does My Makerspace Need?

Obviously, the more equipment your makerspace has the wider appeal it will have for potential members, makers, instructors, guest speakers, etc. Some of the most popular equipment for makerspaces include:

• Laser cutters
• CNC equipment
• 3D printers
• Vinyl cutters
• Metalworking/welding equipment
• Woodworking equipment: table saws, wood lathes, routers, etc.
• Hand tools/power tools – drills, electric sanders, etc.
• Electronic components: computer boards such as Arduino, Raspberry Pi, etc.
• Some makerspaces are even equipping their facilities with sewing machines and heat presses for fashion makers.

The equipment you choose for your makerspace will depend on the type of users at your school. Providing a variety of tools allows students to combine the capabilities of the tools to create amazing finished projects.

HIDDEN BENEFITS OF A LASER

The versatility of the laser means that there are naturally some hidden benefits to incorporating this type of equipment in your school. It's up to your discretion if you want to share all of these money saving ways to use the laser outside the classroom, or if you want to keep them to yourself!

Awards and Plaques

There are numerous awards that your school gives out every year - why not create your own custom awards and trophies with the laser? Creating and producing custom awards can be expensive. Bringing these services in house can have a positive impact on school budgets.

School Signage

Schools need signage throughout their campuses. Classroom signs can be customized for the teacher and room number in just a few quick steps. Directional signs can be created to direct students and visitors through the campus, and architectural signage even be made to showcase your school mascot.

Fundraising Campaigns

When your school is planning their next fundraising campaign, how about something involving the laser? You can custom etch laptops for a donation, or create a commemorative laser-cut holiday ornament to sell? Or create special etched keychains with your school logo. The ideas are endless!

Booster Gifts

Are you looking for a special gift to give to boosters of your school? How about a cozy fleece with the booster's name and school logo engraved? Or personalized travel coffee mugs or water bottles? Even the simplest gifts can mean so much more when customized with the laser.

Club Use

Does your school have clubs that could utilize a laser? Imagine what projects an engineering club or art club could create with access to a laser system. The laser may even spark the idea for a new club, such as an architecture club, that could use the laser for architectural modeling projects!

Events

From sporting events to dances to science fairs, the laser can add a great benefit to your school. Students can use the laser to create signage for the event, create custom giveaways, and add laser cutting to a science project.

COMPARING LASER SYSTEMS

The first question you (or perhaps your administration) may have is, why the wide variety of pricing in laser systems? The biggest difference you'll see in an inexpensive system and an Epilog Laser is the quality of the components and support available from Epilog. Epilog's laser source and motion control components results in much faster engraving and cutting times, and much higher quality of etching. We want to make sure you are up and running constantly with the laser!

Glass vs. Metal Laser Tubes

When you see an extremely inexpensive laser online, there's a good chance the machine is imported from overseas and contains and glass laser tube. Epilog only uses metal laser tubes with ceramic components, which provide a number of benefits:

- Higher Engraving Speed / Resolution
  Metal laser tubes can be fired at a much higher rate of speed than a glass laser tube, which is why our systems run at much higher speeds and with so much more engraving clarity than a glass-tube system.

- No Water Chiller
  All of our laser tubes are air-cooled, so you don't need install or maintain any kind of water chiller or have it near your electronics.

- Longer Lifetime
  Our laser tubes typically last 3 to 5 years before they need recharging. Glass laser tubes require much more frequent replacement.

Laser Safety Ratings

Laser safety should be a priority in any environment, but especially in the classroom.

Lasers are classified for safety purposes based on their potential to cause injury, and are rated from Class 1 (safest) to Class 4 (least safe). Most lasers used in schools are in the Class 2 rating because they are safety interlocked, and will not fire when the cabinet door is open.

A Class 4 laser is one that is not interlocked and can be operated with openings into the laser cavity. These may include pass-through capabilities, where an opening allows you to extend a product outside the laser's work area. This provides an opening for the laser beam to escape and potentially harm the laser operator. Class 4 laser systems also have additional safety requirements, including safety interlocks on doors where the laser system is operated and the appointment of a laser safety officer.

System Ease of Use

Can you send the file from any graphic software program, or are you tied in to a proprietary system? Can you print directly from the program or are you required to take the file into a more complicated job management system? These are important considerations to keep in mind when selecting the right laser system for your school.

Networking Capabilities

Does the laser have a built-in Ethernet connection? As you build out your space and have multiple lasers, a network capable laser allows you to connect all of the systems to a single computer, or multiple computers to a single laser.

EASE OF MAINTENANCE

All laser systems will need maintenance. There are complicated electronics and components within this system that need to be maintained and will occasionally have issues. In choosing your system, ask questions regarding support and understand what type of help you can get when you do face a problem.

Technical Support Process

What is the technical support process when you encounter a problem? The support department should be quickly responsive and be able to diagnose problems through a few simple questions, then overnight any necessary parts. Online support through chat systems can also be helpful in getting systems back up and running quickly.

User Maintainable Parts

Are the systems designed in a modular fashion so that parts can be easily accessed and replaced by staff at your school?

Ongoing Support

After your warranty, what is the process for calling technical support and asking questions or getting parts quickly? You'll want to make sure you've got resources to help you succeed long after the sale has been made.

SETTING UP LASER POLICIES

Makerspaces differ in their policies for using their laser systems; however, the vast majority - at minimum - require an introductory course that explains how the laser works, how to send jobs to the laser, what materials work with the laser, how to clean the laser, etc. Some makerspaces cover this important information in one introductory course, while others break it into two or three more in-depth sessions.

Even after the introduction, some makerspace require using the laser under the supervision of a "maker pro" – someone who works at the makerspace and is considered a seasoned user of this type of equipment. Others require makers to accumulate a certain number of laser hours with a maker pro before being permitted to use the equipment unsupervised.

What works best for you and your makerspace will depend on how many students you have using the laser, how knowledgeable they are with laser equipment, and what you feel comfortable setting as a minimum standard to use this type of machinery.

The design of your training class will depend on your students' use of the system and degree of laser knowledge. Some ideas for class topics include:

The Basics of Lasering

Concepts covered include raster vs. vector jobs, setting up a print job, the print driver, material settings, sending the job to the laser.

Advanced Features

Using the center-engraving feature, color mapping, photo engraving, 3D engraving settings, changing settings on the fly.

Maintenance

Cleaning the system after use, cleaning the cutting table, wiping off the lenses.

WHAT ELSE DO I NEED TO GET STARTED?

An important question to ask is, what is included with my system, and what else will I need to get up and running with the laser?

- A Laser System
  Laser system pricing will vary depending on the engraving area, wattage configuration, and any additional accessories you might want to include. Later we'll discuss lease-to-own options and what wattage is right for your needs.

- A Computer
  Any Windows XP, Vista, 7, 8, 10, or 11 operating system is recommended. All of the versions of 2000, XP, and Vista (Home, Professional, etc.) are compatible with an Epilog Laser system.

- Graphic Software
  Epilog's systems are designed to run on most Windows-based graphic software programs, such as CorelDRAW, Adobe and AutoCAD. The system comes with a print driver that will send your images from any of these programs.

- Filtration or Exhaust System
  All laser systems must be exhausted or filtered. As the laser engraves and cuts, the material is vaporized, but the smoke needs somewhere to go. You have two basic choices: exhaust to the outside, exhaust the air from the laser into a portable filtration unit.

  If you choose to exhaust to the outside, all you need to do is attach a small exhaust fan to the back of the system, and blow the smoke out of the building.

  If you are in an area where you can not exhaust to the outside, you'll need a air filtration unit. There are several good filtration systems of the market that your distributor can recommend for you.

- Laser System Features/Options
  Depending on what laser system you choose, there are several accessories that are standard inclusions, and also ones you can add after you purchase. While many of these come as standard equipment with an Epilog Laser system, you will want to make sure you have them on any system you purchase.

  - Air Assist
    Allows you to attach an air compressor to the unit, which blows a constant stream of air at the point of burn. Helps reduce any flare-up from combustible materials.

  - Auto Focus
    Automatically focuses the laser to the correct engraving height.

  - Vector Cutting Grid
    This is an essential feature if you are cutting through materials.

  - Rotary Attachment
    If you want to etch glasses, mugs, wine bottles and other cylindrical objects, you will need a rotary attachment.

ONGOING MACHINE MAINTENANCE

There is a variety of ongoing maintenance that needs to be considered when adding a laser system to your educational facility. Keeping the machine well maintained can add years of use. Below is a list of common cleaning tasks that, when done regularly and properly, can help extend the life of your laser.

- Keep the Lenses Clean
  Wipe off the lenses once a week (or whenever they are dirty, depending on the usage). To clean the optics use a high-quality cotton swab moistened with the optics cleaner supplied in the accessory kit.

- Clean the Linear Encoder Strip
  On some systems you'll have a linear encoder strip that needs to be cleaned approximately every 90 days.

- Debris in the System
  This is one of the most important cleaning processes that should be done regularly. Dust and debris that builds up in the system can damage many components of the system and should be removed regularly. Have students get into the habit of wiping down the machine regularly.

- Emptying the Vector Cutting Table
  Debris also gets collected in the system's cutting table. This debris can build up over time and can become tinder if it is allowed to build up too much inside the table. Empty the vector table daily to keep your system safe from this danger.

- The Laser Tube
  The true consumable on the system is the laser tube, which needs to be recharged or, depending on the type of system, replaced. Glass laser tubes tend to need to be replaced every 3 to 12 months. Metal laser tubes tend to need to be recharged every 3-5 years. Depending on wattage, recharging a metal laser tube can range from approximately $1,200 to $2,200.

WHAT PRODUCTS CAN YOU CREATE?

Architectural Models	Awards
Corporate Gifts	Custom Cabinets
Desk Sets and Accessories	Decorative Tiles
Electronic Gadgets	Furniture
Glassware	Gunstocks
Key Chains	Laptop Covers
Mobile Phones	MP3 Players
Nameplates	Name Badges
Notary Seals	Picture Frames
Photo Albums	Plastic Signage
Promotional Items	Rubber Stamps
Sporting Goods	Toys
Wine Bottles	Wood Signage

What Materials Can You Use?

Acrylic	Anodized aluminum
Bamboo	Ceramic
Corian	Fabric
Glass	Granite
Laserable plastic	Leather
Marble	Matte board
Onyx	Paper
Pressboard	Rubber
Slate	Stone
Tile	Wood

And much more!

WHY WILL THE LASER BE THE MOST POPULAR TOOL AT MY SCHOOL?

When the votes come in, you'll quickly see why the laser is frequently cited by schools as the most popular tool in their class rooms or makerspaces. The system's popularity stems from a combination of the ease of use of the system and the versatility of materials you can work with. While 3D printers may get more 'wow' factor initially, students tend to spend the majority of their time on the laser system.

Ease of Use

The popularity of the laser can be an important consideration when deciding where to spend your budget.

The higher the wattage, the thicker the material you can cut through in a single pass. On a 30 watt system, you can cut through up to 1/4" hardwoods and acrylics in a single pass, while a 120 watt system will allow you cut all the way through up to 1/2" thick materials. A lower wattage can cut through thicker substrates using multiple passes as well.

Versatility

Higher wattage systems also allow you to engrave some materials at higher speeds to get to the same engraving depth. For example when engraving wood, on a 60-watt system you might run the laser at 100% speed 100% power to get the perfect engraving depth, but on a 30 watt system you may slow that down to 40% speed to increase the laser's dwell time and to achieve the same engraving depth.

DEFINING SUCCESS THROUGH METRICS

Many educational makerspaces find it helpful to showcase the benefits that they are able to add to schools by adding specific metrics to highlight the usage of the space to school administration. This can be as simple as a dashboard highlighting the overall student usage of the space, to more detailed metrics including how the space is used and what departments are using the space most often. Start collecting data immediately upon starting the makerspace to make sure you have the data you'll need down the road.

Sign-in Tracking

Track usage of your space on a daily basis by requiring a sign-in to the space. This can be done through a simple sign-in sheet, or you can use various iPad sign-in apps or ticketing systems.

Track Who Uses the Space

Have students include their major or course for which they are using the machinery.

Track How They Are Using the Makerspace

What type of projects are students using the machine for most often?

- Class Projects
- Curriculum Integration
- Prototyping
- Personal Projects

Track the Role the Space Fills

Survey your users to find out if the makerspace was a deciding factor when deciding to enroll at your institution, if they saw the space during a school tour, and if the resources offered support student retention.

Surveys can also provide information on what the students are learning in the space that they aren't able to through regular classroom learning, as well as demographic information.

CURRICULUM IDEA 1: CREATE A CUSTOM KEYCHAIN

Project Description:

For a first laser project, a keychain can be a quick and easy way to learn many of the essential basic lessons needed on all future projects. Have the students take a piece of wood and design a keychain using their own custom design.

Material Needs:

- Wood sheets
- Keychain Rings

Concepts Covered:

- Setting up a basic laser project
- Page setup
- Creating a vector cut line (vector vs. raster discussion)
- Importing a graphic
- Using the laser's print driver
- Material settings
- Sending a job to the laser

CURRICULUM IDEA 2: ARCHITECTURAL SIGNAGE

Project Description:

Signage design can incorporate a wide variety of styles from simple name-plates to designs incorporating a wide variety of materials and dimensions. Have students identify a signage need in your school - a classroom number sign, an event sign, or a club signup sign, and have them design and create a new sign using the laser.

Material Needs:

- MDF
- Cardboard
- Engravable Plastics
- Paint
- Miscellaneous Materials

Concepts Covered:

- Setting up vector cut lines
- Using frequency to improve cutting
- Design using mixed media
- Working with a customer on design

CURRICULUM IDEA 3: WORKING WITH FABRIC / FABRIC DESIGN

Project Description:

Lasers are increasingly being used in fashion design, including direct to fabric engraving and creating intricate cut-out patterns. Have students find a piece of old clothing - their own or from a thrift store- that they can customize with the laser!

Material Needs:

• Old clothing, shoes, etc. from home or from a thrift store

Concepts Covered:

• Working with resolution on different materials
• What materials engrave best with a laser?

Project Inspirations:

• Laser etch jeans with a pattern that is repeated throughout the material.
• Laser engrave a design on leather shoes.
• Laser cut a custom pattern in a dress.

CURRICULUM IDEA 4: CREATING A 3D MODEL

Project Description:

By using inexpensive materials like cardboard or Taskboard, you can create 3D models that work like a puzzle that you put together yourself. Students can work with Fusion 360 software from Autodesk to take their 3D image and slice it for the laser.

Material Needs:

• Cardboard
• Taskboard
• Dowell

Concepts Covered:

• Creating a 3D model
• Using Fusion 360 software
• Laying out a multiple piece model with the laser

CURRICULUM IDEA 5: CREATING A BOX WITH A CUSTOM INLAY

Project Description:

The incredible precision of the laser allows you to create highly-detailed inlays. Using this idea, create a wooden box cut with the laser that incorporates a wood veneer inlay design.
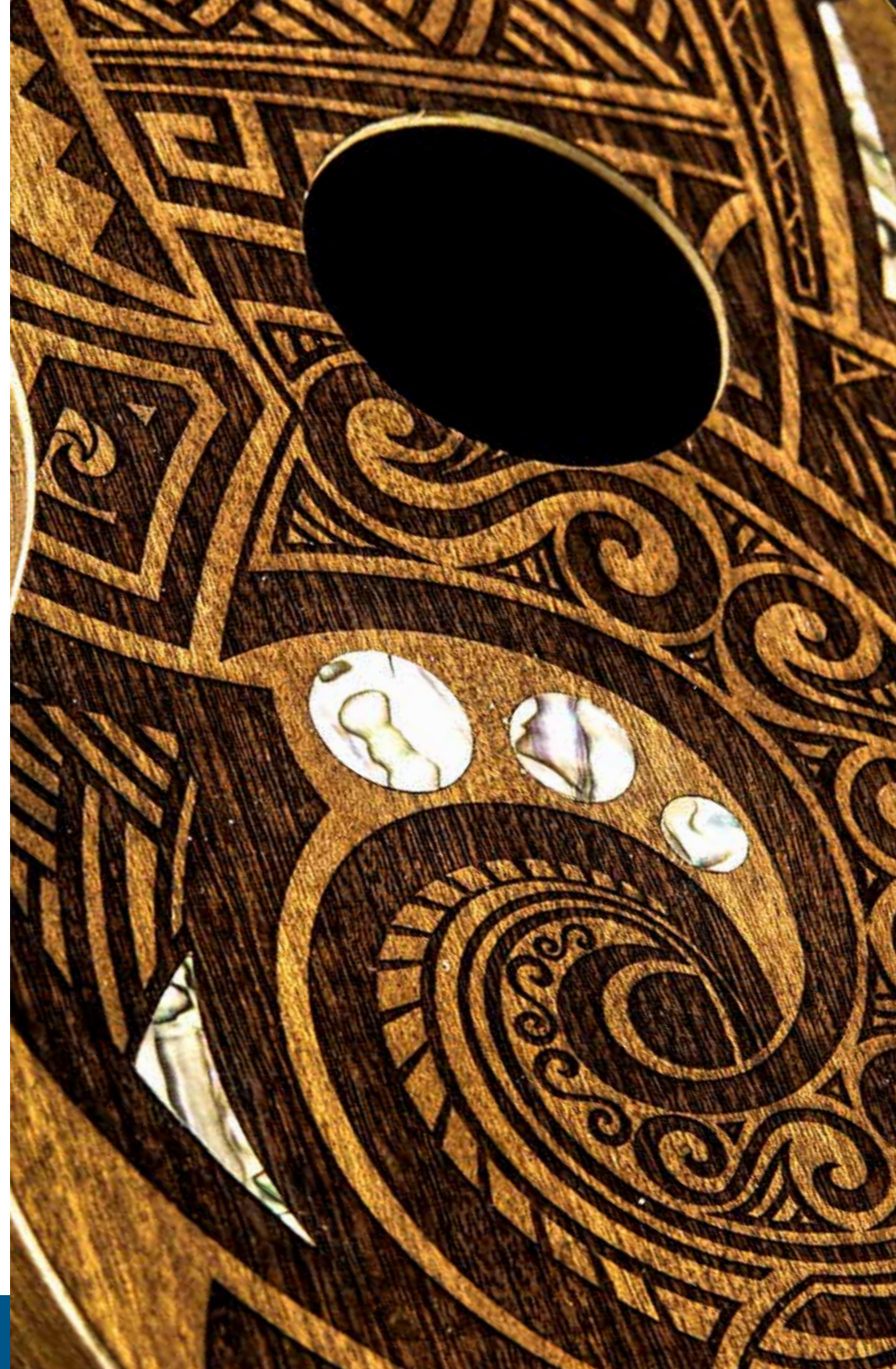
Material Needs:

- Wood veneers
- Wood sheets

Inspiration File:

www.epiloglaser.com/resources/sample-club/wood-inlay-box.htm

Concepts Covered:

- Engraving a pocket for an inlay
- Cutting thin veneers
- Building a 3D object from 2D materials

CURRICULUM IDEA 6: CREATING A PROTOTYPE

Project Description:

Taking all of the concepts learned in the laser classes, create a finished prototype. This can incorporate multiple materials

Material Needs:

- Scrap materials: wood, acrylic, plastics, etc.
- Electronics: Arduino and Raspberry Pi Kits

Concepts Covered:

- Using a laser to cut 3D prototype objects from different materials.
- How can the laser be used to create a finalized design?

Project Inspirations:

- Instructables.com
- Make.com

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