



THE JOY OF LASER CUTTING:

Using recipes and food to teach digital manufacturing

by

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Abstract

Laser cutters are powerful and versatile tools that can introduce significant untapped potential to creative practitioners. However, currently available learning materials for working with these machines are not designed with these users' needs or interests in mind. To address this gap, I developed the Joy of Laser Cutting. This project uses recipes, food and visual language from the world of cookery as tools to reframe online DIY tutorials and appeal to creative practitioners. Interviews with artists and specialists who currently work with laser cutters were conducted to better understand the challenges and opportunities that this technology presents. Finally, workshops were held in which users engaged with the project to provide insights that fed back into the final design. This thesis identifies the importance of demystifying digital fabrication and presenting laser cutters as complex and imperfect mediums that offer users the opportunity to master them and expand their creative potential.

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To Avrum Laurie.

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CHAPTER 1: Introduction

There is an excitement that surrounds digital manufacturing machines like 3D printers and laser cutters. They provide a bridge between the digital world and the physical world and in doing so offer us a glimpse into the future. The potential that this technology presents captured my interest and without knowing exactly what these machines could do, I wanted to engage with them and explore where they could take my art practice.

The challenge I encountered as I sought out online information for engaging with laser cutters is that the information available is mostly aimed at industrial audiences or hobbyists. There is very little content designed with artists' interests and needs in mind. Online tutorials and guides are either technical in nature or the projects they present are utilitarian and practical rather than inspiring. This kind of material didn't resonate with me and it made me wonder if it resonated with other creative practitioners. This technology has a lot to offer users that come from the world of art, design and craft, but the narrow way in which it is presented can be alienating and as a result, the potential that this technology can offer these fields may not be clear.

This thesis has grown out of my experience as an artist looking to interact with laser cutters. When I couldn't find information that served my needs, I set out to teach myself. What began as a series of experiments to learn how to use these machines evolved into an interest to teach other practitioners working in art, design and craft how they too can connect with this technology. This journey culminated in the design and development of the *Joy of Laser Cutting* project - an online tool aimed at teaching creative practitioners how they can work with laser cutters.

The *Joy of Laser Cutting* offers a unique approach to the presentation of an online tutorial. This project uses a recipe format and visual language from the world of cookery in order to evoke familiarity and invite engagement with this technology. This project is influenced by my own creative interests in working with food imagery and pushing laser cutting as a medium. The result is a project that is looking to specifically appeal to creative practitioners in a way that no current online material does. This project is in no way a substitution to hands on interaction with laser cutters but rather serves as a way of presenting what is possible so that users might then seek out informed interactions with these machines.

This development of this thesis work has been guided by the following research questions:

- How can I effectively engage creative practitioners to explore laser cutting?
- How can online resources for learning laser cutting be re-imagined to better cater to the interests and needs of creative practitioners?
- How can food imagery and a recipe format be used as tools for teaching how to work with new technologies while providing room for creative input and improvisation?

1.1 Thesis Overview

The work that was made as part of this thesis and the related research will be presented in the following chapters:

Chapter 2: Methodologies

This thesis begins with an exploration of the methodologies used throughout the different stages of this project. I will outline the importance of iteration in developing the tutorial projects and for advancing the overall design of this project. I will also explore the methodologies used for conducting expert interviews and in running workshops that were organized for the purpose of collecting feedback on the *Joy of Laser Cutting* website.

Chapter 3: Literature Review

The literature review closely considers three elements at the heart of this project: recipes, food and online DIY tutorials. I will explore the history, context and symbolism of recipes and food and how they ultimately played a role in shaping this project. It is my belief that in adopting the recipe format and using food iconography, I am invoking familiarity and inviting greater participation with the material presented. I will also look at online DIY tutorials with a focus on the opportunities and challenges that the medium presents and how these lessons might be applied in the development of my own approach to online tutorials.

Chapter 4: Digital Fabrication and Laser Cutting

In this chapter I will take a close look at digital fabrication and laser cutters, the perceptions that surround them and how they ultimately influence engagement, particularly with creative practitioners. I will also present insight from a series of interviews I conducted with a number of artists who work with laser cutters as well as specialists who have experience teaching or facilitating laser cutting. These conversations were invaluable to better understanding the challenges and opportunities that this technology presents.

Chapter 5: The Work

This chapter will provide an overview of the evolution of this project over the past four years. From my original experience learning to work with laser cutters, to my transition into teaching others to work with this equipment, to ultimately pulling these experiences together into a cohesive project. This chapter focuses in on the lessons learned through all these experiences and how they informed the development of the *Joy of Laser Cutting*. The final section in this chapter presents a detailed look at the *Joy of Laser Cutting* project: the format and content of the tutorials, the workshops I hosted to test the material and the feedback I received from participants. This chapter also includes an overview of the final thesis show and how the work displayed speaks to the broader themes explored in this thesis work.

Chapter 6: Conclusion

The conclusion to this thesis will reflect back on the work that was done and identify ways in which this project accomplished the goals it set out to achieve as well as identify areas of study that warrant further exploration. This concluding chapter will also present a reflection on how my artistic practice has played a role in the development of this project and where this work can be taken in the future.

CHAPTER 2: Methodologies

This thesis work has evolved in different stages over the past four years and its development has required drawing on several different methodologies that I employ as an artist, designer and researcher. The key methodologies employed in the development of this project were practice-led research and iteration. For the purposes of conducting research I also did a series of expert interviews and recipe(tutorial) testing with users.

2.1 Practice-Led Research

This project began with a recognition that there was a shortage of instructional material for creative practitioners to learn how to use laser cutters. To make up for this lack of material, I depended on practice-led research. This was un-aided, deep engagement with laser cutters through which I learned what these machines could do, how I could use them in my practice and how this experience might benefit others. In *Art Practice as Research*, Graeme Sullivan describes the studio experience as “a form of intellectual and imaginative inquiry, and the studio is a site where research can be undertaken that is sufficiently robust to yield knowledge and understanding that is individually situated and socially and culturally relevant” (Sullivan 67). My studio practice was not only the site where I learned to work with laser cutters, but also where I saw the value of sharing the knowledge I was collecting with others. As this project grew, I would go back to my studio practice at times when I felt I had no script to follow. One example of this is when I was tasked with developing the design of a laser cutting curriculum for a continuing education class. To design a logical lesson plan, I thought back to my own experience of learning laser cutting skills. What are the essential laser cutting skills? How would I order these in a sequence that would make sense to others? The answers to these questions came from reflecting on my own experience and from working through a few examples to see how they fit together as part of a larger narrative.

2.2 Iterative Design

Iterative design is a process for testing ideas with rough prototypes early in the design process as a way of arriving at more robust final designs (Macklin and Sharp 106). This cyclical process allows for designers to prototype concepts, test with users, and feed those insights back into the design process before arriving at any final work. Another term for the iterative design cycle is rapid prototyping, a term that is also used when speaking to digital fabrication machines like laser cutters and 3D printers. These are machines that facilitate quick, low cost physical outputs based on digital files. The speed and versatility of rapid prototyping (RP) lends itself to being a part of an iterative design methodology by allowing for quick, low-cost physical objects that can be used to test design concepts (Ranson and Lahn).

In working closely with laser cutters, I naturally adopted an iterative design methodology in the development of the various laser-cut works that I made early on in my adoption of this medium and later in the design of the *Joy of Laser Cutting*. This way of working was especially useful in the development of the individual project recipes, as there were many considerations that needed to be met.

This iterative approach would go on to inform a broader methodology in the development of this thesis. This work has necessitated a willingness to try things out, learn from these experiences and feed the lessons learned back into new versions. It is through this approach that my first prototype, #MKRCookie would go on to evolve into my second prototype, the *Joy of Laser Cutting*. You can read about how this evolution took place in Chapter 5.

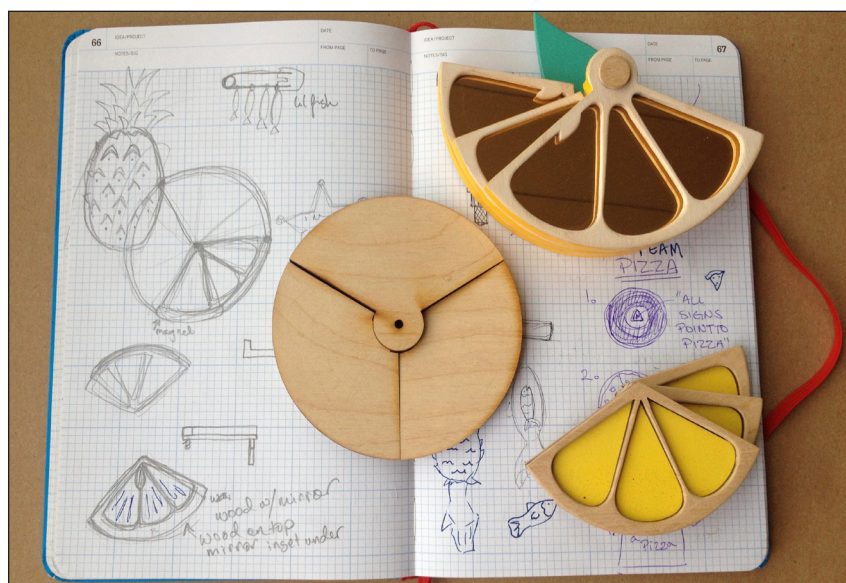


FIGURE 1: Process photo of lemon wedge design. July, 2014

2.3 Expert Interviews

To better understand the ways in which artists connect with laser cutting technology, I conducted a series of interviews with laser cutting experts: artists using laser cutters in their practice, makerspace facilitators, educators who teach digital manufacturing in school settings, and laser cutting service centre staff. Interview participants were supplied with an Informed Consent Form as part of the Research Ethics Board process. The interviews themselves were conducted through Skype or over email. Skype interviews were guided with a set of questions, but were open to exploring conversation topics that came up naturally. These interviews were recorded and later transcribed. Key insights from this process can be found in Section 4.5.

2.4 Recipe Testing

In order to collect feedback on the *Joy of Laser Cutting* project, workshops were conducted with users. The first took place with participants of ITP Camp, a month long unstructured summer camp for creative adults hosted in the Interactive Telecommunications Program (ITP) at New York University. The second workshop took place at OCAD University. The participants for this workshop were recruited online via a Facebook post on my personal profile and on the OCAD University student Facebook page.

All attendees were informed that the workshop was part of my research in advance, but participation in the research component was not mandatory for taking part in the workshop.

Participant observation, including note-taking and candid photography, was used during both these workshops. Participants who signed the informed consent forms were contacted after the workshop with a set of 10 questions. Any photos that were taken of attendees who did not wish to participate in the research were destroyed. A summary of the results of these workshops can be found in Section 5.5.

As an artist and designer, methodologies like practice-led research and iterative design came naturally to me as they were already an integral part of my own practice. As this thesis evolved, it necessitated my stepping into the role of researcher and educator. For this expert interviews and workshop testing were incorporated into my process. While these methodologies were new to me, they provided invaluable feedback that helped inform the *Joy of Laser Cutting*.

CHAPTER 3: Literature Review

This online project is shaped around the use of recipes as the format for presenting the laser cutting tutorials developed. This is complemented with the use of food imagery as the subject of each of these tutorials. For the purposes of this literature review I will closely consider the broader context of recipes, food imagery and online DIY tutorials and how these informed the development this project.

It should be noted that while this work considers craft practitioners as potential users of the *Joy of Laser Cutting*, the research presented here does not include a consideration of craft pedagogy. This omission should be seen as a result of the limited parameters of this work, as a careful consideration of craft pedagogy presents a fruitful opportunity for further contextualization.

3.1 Recipes

Before recipes had a recognizable form, they had a purpose. Early recipes were a loose set of instructions, notes on scraps of paper. They were recorded in family books and sometimes even bartered between friends (Pennel and DiMeo 15). The ultimate purpose of a recipe was to make some obscure technique clear and to make note of a process that worked. They were a way of sharing the accumulated experience of home chefs and home keepers (Pennel and DiMeo 6).

Recipe collections began being published as early as the 1500s, but it is the publication of recipe collections by professional chefs who changed the role of the recipe. An early example of this is the 1660 publication by celebrity chef Robert May. *The Accomplisht Cook; or The Art and Mystery of Cooking*, lay bare everything Robert May had learned over his 55-year career as a chef to the aristocracy. In her exploration of this text, author Sandra Sherman notes that May was looking to make available to all skills that were previously only taught through apprenticeships; skills that were out of reach for most. According to May, his attempt to democratize cooking through the publication of his recipes turned many of his contemporaries against him (116). The recipes and techniques he was sharing were, after all, trade secrets and a source of livelihood for professional chefs of the time. From the preface in his book:

As to those who make it their business to hide their Candor under a Bushel, to do only good to themselves, and not to others, such as will curse me for revealing the Secrets of this Art, I value the discharge of my Conscience, in doing Good, above all their malice; protesting to the whole world, that I *have not concealed any material Secret* of above my *fifty and five years Experience*. (May A5v)

The dissemination of specialist knowledge through recipes or recipe-like guides was not limited to the world of cookery. William Eamon is the author of *Science and the Secrets of Nature: Books of Secrets in Medieval and Early Modern Culture* a text that explores the wide range of early how-to writing. In this book, he notes that starting in the 1550s, in part fueled by the rising popularity of print, there was a surge of how-to books appearing across a wide range of fields, fundamentally changing who had access to specialized knowledge. "The general availability of craft, medical and alchemical recipes tended to demystify trade secrets, reducing them to simple formulas and procedures" (Eamon 131). Information was no longer safeguarded by any exclusive guilds or schools, it was accessible to anyone who could read.

As an example, up until that point artists depended on apprenticeships to learn how to paint, sculpt, and make the pigments, varnishes and tools they would need for their craft. *Il Libro dell'arte* (The Craftman's Handbook) by Cennino Cennini is just one example of a how-to text that compiled all the recipes, instructions and even went on to outline how to be an artist (BoI, The Recipes Project). This text, Cennini writes is "for the use and

good and profit of anyone who wants to enter the profession" (Cennini). Much like Robert May's efforts, Cennini's collection was designed to share his specialized skill set and knowledge with the public.

The evolution of recipes as a way of sharing experience and expertise is something that is inherent in the form. The Latin root of recipe, *recipere*, not only speaks to the transaction of information, but also carries with it the sense of being responsible for something (Pennel and DiMeo 10). William Eamon describes recipes as:

...the record of trial-and-error experimentation. They are the accumulated experience of practitioners boiled down to a rule. We trust recipes because we know that behind them stands someone who does not use them. (Eamon 7)

The implicit confidence with which recipes present information sets them apart from any other format.



FIGURE 2: Cover to the First Edition of *The Joy of Cooking* published in 1931 and the 75th anniversary edition published in 2006

By the 1900's recipes for communicating cooking instruction had begun to take a more standard and recognizable form. They included "... precisely quantified ingredients separated from, and usually preceding, a logically arranged set of instructions for preparation, ... cooking and quantities produced" (Pennel and DiMeo 6-7). In some cases, this basic information is supplemented with suggested serving instructions, photos of the process or the final result.

While still maintaining their intended function, recipes have always been a tool that can be adapted to the trends and needs of the time. *The Joy of Cooking*, the inspiration for this project's title, is one book where we can see how recipes as a format adapt along-side our needs and tastes both in content and form. First published in 1931, author Irma Rombauer wrote *The Joy of Cooking* using what is now known as the action method- the folding in of ingredients throughout the directions. Rombauer's direct and conversational manner felt like you were learning from a friend - an approach that proved a success with audiences living through the Great Depression. Irma understood the challenge of putting food on the table. In *The Joy of Cooking*, she highlighted recipes that were "inexpensive and good" and even included an appendix with suggestions for making the most of leftovers, stale bread, bones, coffee grounds and pickle vinegar" (Mag). This stylistic choice set *Joy* apart from other cookbooks of its time and became the book's signature for the next 60 years (Mendelson). With subsequent editions, the book was updated based on the tastes and daily

realities of its readers. This included adjusting recipes to consider war rations, slowly incorporating frozen ingredients based on growing availability and over time adding recipes from around the world. By the 1997 edition, the conversational approach was abandoned in favour of presenting recipes as a concise set of ingredients and directions. This change in form acknowledged that readers were familiar with how to use recipes and preferred a more direct and succinct presentation for their everyday use (Mendelson).

Outside of the world of cooking, using a recipe format became a short-hand for breaking processes down into easy to follow steps. A well-known example of this strategy is *The Anarchist Cookbook*, published in 1971. Written by William Powell, *The Anarchist Cookbook* is a collection of guides, methods and recipes for growing and preparing drugs, performing electronic sabotage, building weapons and explosives, and generally bringing about social disorder. Powell wrote the cookbook by collecting the techniques described in a wide range of military manuals. He believed that if the government and rebel groups had this information, it should be available to everyone (Siskel, American Anarchist). In the 40 years since its publication, *The Anarchist Cookbook* has been linked to countless terrorist attacks and school shootings including the Oklahoma City Bombing and the Columbine school shooting (Siskel, American Anarchist). The effectiveness of his book would ultimately haunt Powell. In 2000, he publicly denounced it on its Amazon listing. In a comment, he wrote: "I want to state categorically that I am not in agreement with the contents of *The Anarchist Cookbook* and I would be very pleased (and relieved) to see its publication discontinued. I consider it to be a misguided and potentially dangerous publication which should be taken out of print" (Powell, *The Anarchist Cookbook* listing). His strategy for presenting these dangerous techniques in an approachable manner had worked- of course he had no way of controlling the intentions of those who would use them.

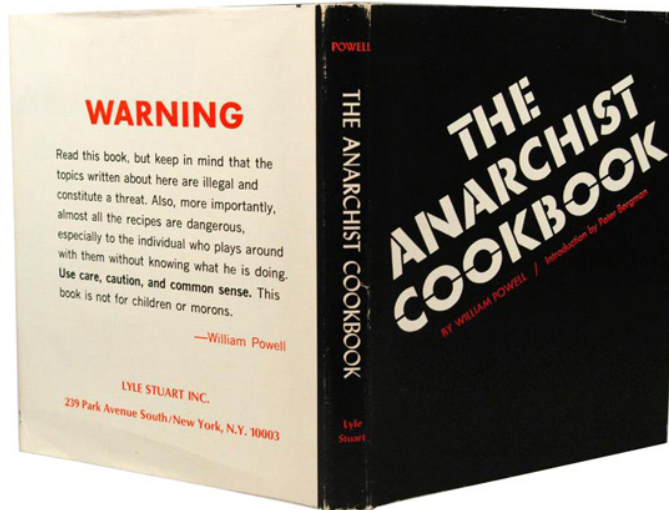


FIGURE 3: Cover to the First Edition of the *The Anarchist Cookbook*, published in 1971

In recent years the recipe format has continued to evolve along with the way that we consume information. Recipe sharing shifted from renowned chefs publishing cookbooks to share their cooking techniques with the home cook, to home chefs gaining fame through their personal blogs, *YouTube* channels or *Instagram* accounts. Popularity is no longer determined by who is developing the best recipes, but rather who is putting together the most appealing cooking guide (Wakkary, Schilling and Dalton 3). Current trends rely heavily on the use of styled and sublime photography rather than the documentary photos used in early cookbooks (Creative Review). These trends and techniques for recipe presentation were closely considered in the design of the *Joy of Laser Cutting* tutorials and website.

Perhaps the most attractive reason to consider recipes as a format for this project is that at the same time that they provide guidance, the form implies that there is room for users to diverge from what they are presented with. Sarah Sceats, author of *Regulation and Creativity: The Use of Recipes in Contemporary Fiction*, points to the creative potential that recipes offer “In its essence a recipe is a blueprint and an inspiration, a contradictory mixture of given rules and creative possibility” (Sceats 169). Recipes are guides, not laws. They invite participation through improvisation and substitution of ingredients, based on what users have on hand or personal taste. This is an important consideration since this is how recipes evolve; through an organic process of remixing by personalizing, substituting and experimenting. This aspect of recipes is only magnified through the sharing of recipes via social media where posting a single photo can quickly snowball into a global trend. Audiences are approaching recipes with an excitement to participate and make them their own like never before (Wilson).

The recipe format is a tool that has long been used to demystify and disseminate valuable and complex processes. As I have explored, both in and out of the world of cooking, recipes are a tried and tested approach for teaching new techniques. They are familiar but also adaptable to the needs of authors and audiences. Importantly, they also leave room for audience participation. Recipes also have a history of being used as a way of sharing art processes. Working with the recipe format means tapping into a shared understanding of how recipes operate- making them a compelling approach for re-imagining the way that DIY tutorials can be presented.

While researching this work, I was pleasantly surprised to find that I was not alone in seeing the potential in bringing together the world of recipes and DIY tutorials. Dale Dougherty is the founder and publisher of *Make:* magazine, the largest DIY culture and project magazine. In his book *Free to Make*, he describes how he initially pitched the idea for producing a magazine for makers: “I explained that this new magazine was a “*Martha Stewart* for Geeks.” It would be a magazine with “recipes” for projects that you could do, with new technology on the ingredients list.” In looking for a way share new technology project guides, Dougherty looked for a format that could easily be understood and found recipes. *Make:* magazine has since grown into just one part of a global *Make* empire that includes *YouTube* channels, Maker Faires, and a wide range of books focusing on a different DIY techniques.

3.2 Food Imagery

Familiar food forms were chosen as the subject of the tutorial projects I developed for a number of reasons. For starters, they are the most natural way to complete the metaphor given the recipe format being used. By using food in combination with the recipe presentation I am looking to trigger users’ familiarity with recipes and cooking.

The use of recognizable food items as subjects also serves the additional job of drawing in the curiosity and interest of viewers. People are drawn in by the sight of prepared food, whether it is real or not. Author Chi-Hoon Kim writes about the tradition of creating plastic and wax food replicas to display outside Japanese and Korean restaurants. He notes that this practice became widespread in Korea as a way of appealing to tourists in advance of the 1988 Olympics in Seoul and the 2002 World Cup. The idea being that food replicas could appeal to viewers across language barriers (Kim). In the development of the individual projects used in the *Joy of Laser Cutting*, efforts were taken to ensure that the sample projects were designed around accurate representations of iconic food items. These pieces were enhanced by drawing on current trends in food photography and styling.

The advantage to working with food as a subject is that it offers a way for just about everyone to connect with the material. It is universal and ordinary but also specific to moments in history and from our own lives.

Through smell, and by extension taste, food is able to tap into our memories, transporting us (Hirsch 188). But even when we are not eating it, food presents a wide range of meaning. Roland Barthes, argues the value of considering food to be more than just sustenance in his essay *Toward a Psychosociology of Contemporary Food Consumption*. In it, Barthes posits that food is "... a system of communication, a body of images, a protocol of usage situations and behaviours" (Barthes 23). This connection to the world around it allows food, and representations thereof to tap into our personal experiences with it at the same time that we access its broader significance within society. This means that even unfamiliar food can trigger some understanding of the role it plays in society and the attitudes associated with it.

The power that food has to communicate about the world around it is one of the reasons that it is a popular subject in the world of art. From Dutch renaissance still life paintings to vibrant oversized Pop-art sculptures, to food replicas made of felt and yarn, food is an extremely effective and engaging way through which artists have been able to comment on the ways society is changing around them (Oehler 205).

Andy Warhol's body of work with the Campbell's soup can is an example of how food can be used as social commentary in the world of art. Warhol became fascinated with the image of the soup can out of his own repetitive habit of having soup for lunch (Oehler 206). At the time, Campbell's soup was heavily marketed to house-wives as a fix-all solution for home cooking. The can stood for the convenience and consumerism that changed the way that Americans ate through the 50s and 60s. Warhol began working with the image of the soup can in a series of 32 acrylic paintings: one for each variety of soup available (Figure 5). He said on the series: "The reason I'm painting this way is that I want to be a machine," (Oehler 208). A machine like the one that produced the soup cans for his lunch. He would go on to take this fascination one step further by moving to work with screen printing, a medium that more closely matched the automated, mechanistic, reproducibility that the Campbell's soup can stood for (Oehler 208). Warhol created a large number of prints of the iconic can at his famous studio: "the factory." He used the repeatable nature of screen printing as a way of tapping into the essence of the Campbell's soup can icon.

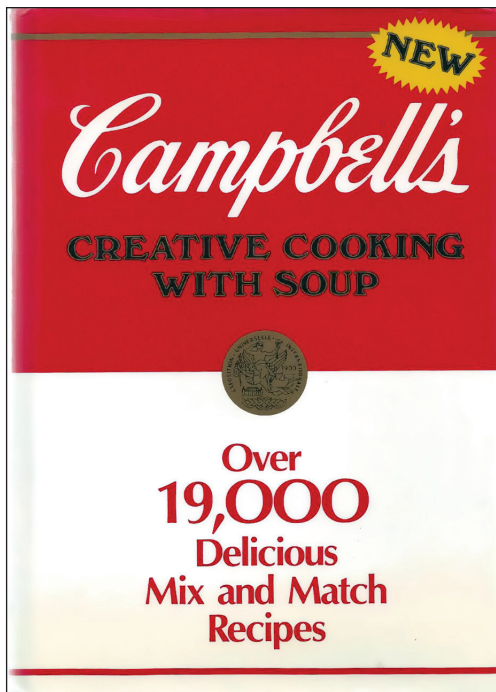


FIGURE 4: Campbell's Soup Company Cookbook,
Published 1985



FIGURE 5: Andy Warhol, Campbell's Soup I. 1968

Much in the same way that Warhol connected food imagery to the medium he was working in, I wanted to place the subjects of the tutorials I developed in conversation with the technology that is being used to make them. I chose industrially produced foods because these are inexpensive, recognizable everyday foods. They are packaged and frozen products that while we associate with being at home, are not home-made; cookies, crackers and waffles that are slightly too uniform and perfect to be made by human hands. In using food items that represent what we consider to be outside the realm of home-made, the tutorials developed for the *Joy of Laser Cutting* are tapping into the way that digital manufacturing is stretching and evolving the definition of what we can make in a non-industrial setting: home-made industrial goods.

3.3 Online DIY Tutorials

A large source of inspiration for this project is online Do-It-Yourself tutorials. These guides and tutorials are not unlike recipes, as they are a way of breaking down a process in order to share it with others. These step-by-step instructions make up an important part of maker culture, a subculture dedicated to creating, modifying and sharing the tools and instructions of their process with others (Katterfeldt, Lund and Zeising 123). The areas that these guides cover is as varied as the maker community participants. Tutorial listings on *Instructables*, a popular site for sharing tutorials, range from robotics, to jewelry to paper crafts, knitting, cosplay and electronics, to name just a few. Human-Computer Interaction researcher, Ron Wakkary and his research team at Simon Fraser University explain the crucial role that these guides play in the maker

community in one of their studies on DIY tutorials: “Tutorials not only provide tutorship of particular projects, they also develop the skills and competences of those involved in DIY and, in doing so, expand the culture and practices of DIY” (609). By inviting participation, tutorials and guides make-up the driving force of online DIY and maker communities.

Given that my project would be entering into the world of online, freely available, user-generated tutorials, it has been useful to consider the growing body of research into online DIY tutorial sharing communities that has been done in Human-Computer Interaction (HCI). HCI is a field of study that focuses on the relationship between people and interactive computer systems (HCI Bibliography). These studies look at virtual DIY spaces and identify the challenges and opportunities that come with translating techniques that have traditionally been taught in person into digital formats.

While online tutorials are reminiscent of recipes in their intentions, they differ in that there is no standard for their presentation or format. This leaves the entire structure of the tutorial up to the author. In looking at online tutorial practices HCI researchers identified a number of challenges with online DIY tutorials. The first of these is that the creation of projects and the authoring of tutorial guides are two different processes that are often at odds with each other. In their study *Product Versus Process: Representing and Appropriating DIY Projects Online*, Tseng and Resnick closely considered Instructables - one of the earliest online communities for user uploaded tutorials. In this study, Tseng and Resnick interviewed *Instructables* tutorial authors to find out how they go about developing their project instructions. Through these interviews, they found that “documentation and designing are two separate and often conflicting processes” (426). Their interviewees admitted that in practice, the documentation process is easily forgotten while working through a project. Most often, once a project has been completed the guide is pieced together using staged project photos or by starting from the beginning for the purposes of documenting (426).

The challenge of translating a project from the real world into an online tutorial, is more than simply a logistical one. Wakkary et al’s study *Tutorial Authorship and Hybrid Designers: The Joy (and frustration) of DIY Tutorials* takes a close look at the elements that result in higher quality tutorials. In their study, the research team sets out to execute a variety of DIY tutorials from different online sources. From this process they were able to identify a number of common issues that got in the way of successfully completing a tutorial project. These issues included instruction inaccuracies, lack of information on tools or components, sequencing errors, communication issues related to use or lack of images and overall assumptions about the user’s competencies resulting again in missing information (5). What these issues highlight is the fact that authors of online tutorials may not actually have the skills to write a good tutorial. Successful online tutorials depend on the clear communication of a process from the original maker to a new user. When tutorial instructions are poorly executed, knowledge is not transferred to the reader and regardless of the original project success, the tutorial is a failure. This is a lesson that I would go on to learn first-hand when I shifted from being a maker to being an educator. My experience of this and the lessons I learned from this process are outline in Section 5.2.

As part of a larger study, Dalton et al, conducted an experiment into what happened when online DIY tutorials were presented in a format that might address some of the shortfalls that they had observed. In *From DIY Tutorials to DIY Recipes*, the research team looked at two DIY tutorials and “translated” them into a minimal recipe format inspired by the style found in *The Joy of Cooking*. In their conclusions, the team states that the simplification of the ingredients and the sequencing was indeed very useful although they note that including additional images to clarify process steps and adding extra details around specific processes would further benefit the specific tutorial needs (5). Dalton et al write: “We see in the recipe format a way to structure and navigate tutorials that are straightforward and that can support at the same time an overview of the project

and detailed information about the different steps” (5). The recipe format offers a standard approach for presenting information. In being a recognizable form with accepted conventions, it serves as a framework for structuring a step-by-step guide. Whereas tutorials developed by individuals are seen to suffer from issues related to the format and content, using the recipe form helped address some of these shortfalls. Dalton et al go on to write on the opportunities that such a cross pollination between fields presents: “... as practices grow along-side others and borrow from each other, we believe that the evolution of cookbooks ... can inspire the development of DIY tutorials” (3).

HCI studies have suggested that the challenges identified in DIY tutorials offer opportunities for interaction designer interventions (Dalton, Desjardins and Wakkary). Going one step further, I would argue that the tutorial could be seen as a place to explore alternative frameworks for sharing expertise and inspiration for the purpose of appealing to different audiences as I looked to do with the *Joy of Laser Cutting*.

Recipes, food imagery and online DIY tutorials are three aspects of this thesis that have remained central to the work through the various evolutions of this project. A close examination of these elements has revealed a rich history and context that can serve in achieving my thesis goals. By better understanding how the recipe form stands apart from other formats, the power of using food imagery and what some of the challenges of current online tutorials fall are, I am able to consider how I can bring these worlds together and leverage the strengths of each.

CHAPTER 4: Digital Manufacturing and Laser Cutting

To better understand the challenges and opportunities presented by laser cutters this chapter will closely consider the origins of this technology and how their role has changed over time. In conversation with artists that use laser cutters and specialists that facilitate interactions with these machines, this chapter will explore the potential that laser cutters present for other creative practitioners and what obstacles may be getting in the way of these interactions, including how perceptions of this technology may be limiting our understanding of what they can do.

4.1 Digital Fabrication

Digital fabrication, sometimes referred to as rapid prototyping (RP), is the use of machines that use additive or subtractive production methods to create real-world outputs based on digital files (Bohne 164). Without the need for the costly master moulds or dies used in traditional manufacturing, digital fabrication breaks with conventions in favour of a leaner, more adaptable approach. The machines that typically fall under the category of digital manufacturing are: 3D Printers, CNC mills and laser cutters. These machines are used in manufacturing either as prototyping tools or on the production floor. Over the last 15 years technological advances have reduced the size of this machinery as well as their average price, making them accessible to users outside of industrial manufacturing settings (Bohne 165).

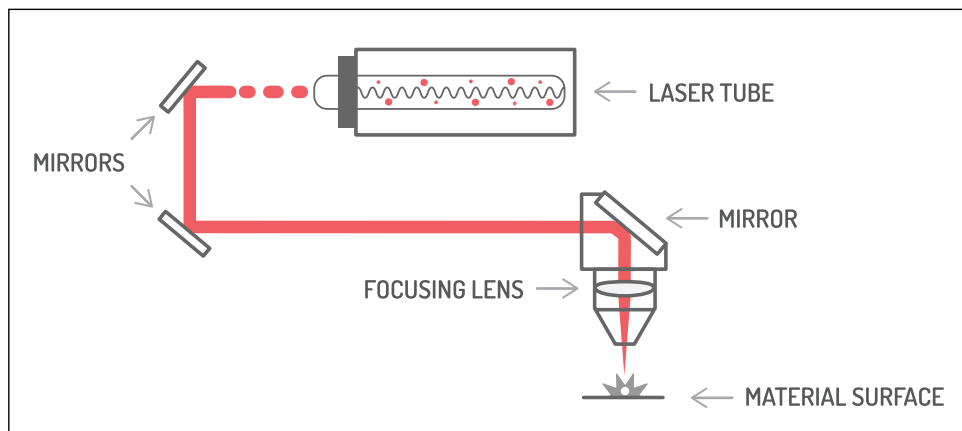


FIGURE 6: Illustration from the Joy of Laser Cutting, 2017

4.2 Laser Cutting

Light Amplification by Stimulated Emission of Radiation or LASER technology was first developed in the 1960s. The first laser cutter, which combined high a powered laser with targeted airflow, was designed in 1970 (Hilton). Laser cutters presented the ability to engrave and cut through a wide variety of materials. The kind of laser and the specific machine's power determined the thickness and range of materials it could work with. The flexibility that laser cutting offered for how materials could be processed made it so that these machines quickly became standard equipment on the manufacturing floor (Hilton).

Laser cutters are not yet compact or affordable enough to be considered tools for the personal or home studio, but they have become more accessible to the public through shared shops, makerspaces, and schools around the globe (Makerspace). Most laser cutters found in these spaces are CO² lasers. These machines are not able to cut through metal or stone but lend themselves to working with a wide range of wood, plastics, paper, textiles and leather.

4.3 Laser Cutting and Artists

As laser cutters are more accessible they become a compelling tool and medium for art, design and craft. With their power and versatility, laser cutters are able to replace a wide range of shop tools; from a table saw, to a utility knife, a hole punch, a branding iron or even a bone folder. In this way, laser cutters are able to facilitate production in a variety of materials. They make it easy to explore and work with new mediums that may be unfamiliar to users. Laser cutters are also able to automate a large part of the labour of production and can easily make multiples. These features can be invaluable for creative practitioners who are having to balance the labour of producing work and the need to price this work for sale.



FIGURE 7: Gabriel Schama, *No Thieves Go*. 2017

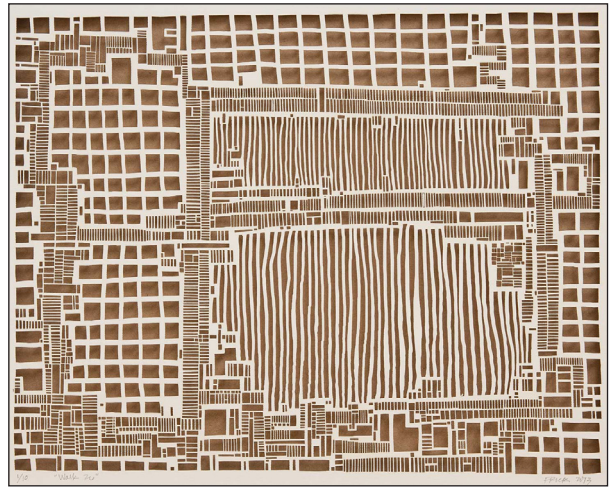


FIGURE 8: Laurie Frick, *Walk 26*. 2013

Gabriel Schama is an Oakland-based artist, whose laser cut pieces have attracted a wide online following. He initially worked as a paper-cut artist, but organized a *Kickstarter* campaign to buy his own laser cutter once he saw what these machines could do. He explained the impact of making this change:

My paper cutting was an incredibly slow process. I couldn't really finish a single large piece in less than forty hours. I might spend more hours than that working digitally now, but once I have a finished design with my laser cutter I can produce one or two copies of that design every day. Without this as the basis to produce larger editions of work, I wouldn't have been able to become a full-time artist. (Personal Interview)

Being an artist is more than just having a vision for making the work, it also requires thinking through the production and considering the cost associated with making it. Laser cutting can be a way for artists and other creative makers to engage with a market that is not always receptive to the real cost of art production.

Laurie Frick, is an artist who translates hand-drawn designs into laser cut paper works. She uses a laser cutter in a shared working space in Austin where she is based. Frick spoke to me about some of the practical reasons she began working with laser cutters: "I'm an artist. I have to be able to make it, frame it, sell it" (Personal Interview). There is a very practical appeal to working with laser cutters. The versatility it offers means that beyond producing the artwork, they are able to facilitate the fabrication of all the materials required to support an art practice; everything from tags, to labels, mats, frames and even prototypes. "It's the part that no one sort of imagines, it's the practical end" says Frick (Personal Interview). Working directly with machinery that can easily produce all of these important yet time-consuming pieces allows for users to focus their energy on the creative work.

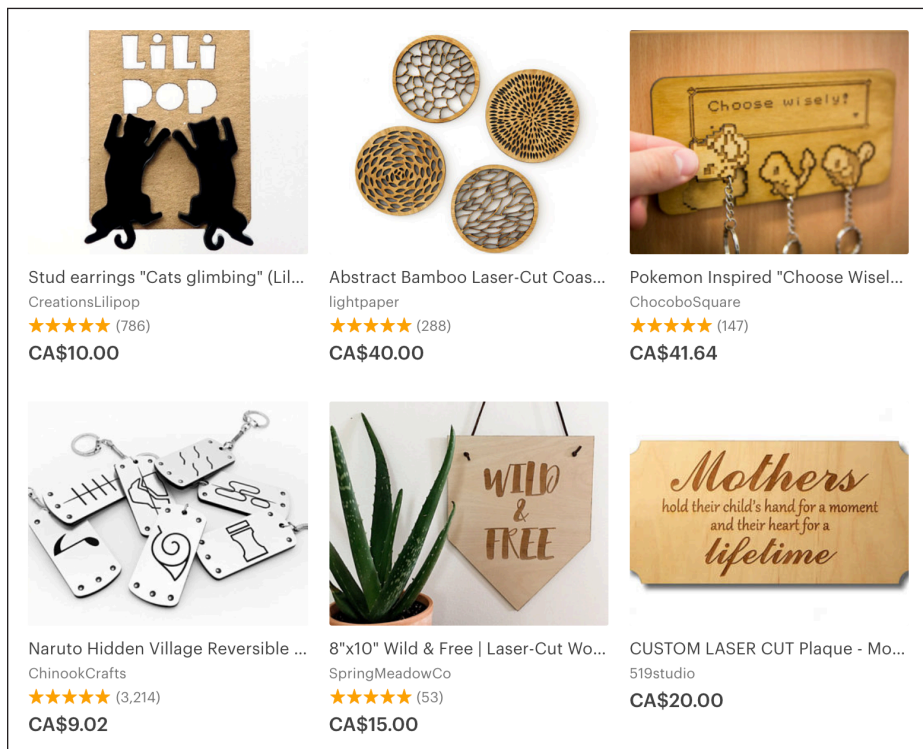


FIGURE 9: A few examples taken from the first page of results on Etsy for the search "laser cut." Sept. 2017

4.4 "Keychain Syndrome"

Laser cutters offer power, versatility and speed in production. They can assist in many practical tasks, but as explored above, they can also offer a compelling medium for creative production. Presently, however, there are few examples of users pushing this technology past its basic functions.

In talking to Laurie Frick, she noted the kind of work that she most often sees being made with laser cutters:

There's very few artists [working with laser cutting]. What I have found, people are using them for menus in restaurants, or they're etching glass bottles. People are making businesses out of it. That's what really struck me with it. People have built personal businesses out of it. Dog collars, little tags, jewellery stands... it's not art, it's Etsy stuff (Personal Interview).

Etsy is a major online hub for small businesses and first-time entrepreneurs. While it initially started as a platform for craftspeople and artists, its rise in popularity has come with a major change in its primary users. Currently it is a leading marketplace for lower price-point mass produced or semi-mass produced goods (Dobush).

Paulo Bilkstein, Assistant Professor at the Stanford University Graduate School of Education, has worked to integrate digital fabrication into elementary school curriculums. Some of the lessons he has learned from this experience can provide insight into some of the pitfalls of this technology.

As part of a series of introductory digital fabrication workshops in 2009, Bilkstein had participating students make personalized keychains. In subsequent sessions, he observed that these students came back again and again to make more keychains for friends and family. They were clearly drawn to laser cutters, but weren't interested in making anything other than keychains. Bilkstein's analysis of this experience is that because laser cutters are able to easily produce items that are visually appealing, there is "a disproportionate payoff in staying at a 'local minimum' where the projects are very simple but at the same time very admired by external observers" (212). Laser cutting can produce very attractive results requiring little design and no post production; it is the perfect tool for making products easily and inexpensively. Bilkstein coined this the "keychain syndrome" (211).

With increased access to these machines through makerspaces and laser cutting service centres, we are seeing a boom of goods being made by individual designers or small scale brands. From jewellery to accessories, home goods and even furniture, these machines are allowing people to enter the world of manufacturing and compete with large businesses while still maintaining a small-scale operation.

Laser cutters have a lot of potential, but we do not often see them pushed past the very basics of what they can do. In talking to artists who incorporate laser cutting in their practice, it was interesting to hear them comment on their explicit interest to move past what Bilkstein called the 'local minimum' or what they termed the "laser cut look."

Speaking about her early explorations with laser cutting Laurie Frick noted that she was much more interested in exploring the results of working with high quality art paper than laser cutting wood, which she was seeing everywhere: "Wood looks like boy scout craft projects to me...it has a look, but it's what people cut" (Personal Interview). Laser cut wood has a very distinct burnt edge and slight surface staining that results from the laser's heat (Figure 10).

Ben Light is a Fellow and Adjunct Professor in the Interactive Telecommunications Program (ITP) at New York University as well as an artist who has many years of experience working with laser cutters. He explained that over time, he has had a growing interest to push past the basics of laser cutting: "I'm trying to get away



FIGURE 10: Example of a laser cut finger joint box. Dec. 2017

from the charred plywood or the acrylic that's so classic. And trying, not to hide the laser, but trying to find something else the laser can do" (Personal Interview).

In his role at ITP, Light also encourages his students to push past common laser cutting tropes. One example is the ubiquitous finger-joint box that gained popularity through free online box file makers (Figure 10). Light described how the "local minimum" limits our perception of laser cutting: "There are really easy ways to use a tool, but it's so easy and used that it becomes this look. And becomes a little common and even becomes, not what you're going for. There is a craftsmanship to laser cutting. And it doesn't mean you're hiding it, you're looking to get the most out of it" (Personal Interview).

Laser cutters at their most basic offer users power, speed and automation. The challenge is to explore what unique possibilities this technology can help us unlock. Creative practitioners can benefit immensely from incorporating laser cutters into their practice because they can replace a wide range of tools, simplify the labour of production, and because they are capable of easily executing multiples. At the same time, our collective understanding of what laser cutters are capable of can benefit and grow from having these practitioners push the medium in new directions.

4.5 Laser Cutters IRL

Having considered the possibilities and challenges that laser cutting presents for creative practitioners, I wanted to better understand the spaces where these users currently connect with this technology. For this I spoke with three specialists: Hillary Predko, who has taught at local makerspace Site 3; Ben Light, who teaches digital manufacturing in the ITP at NYU; and Matt Compeau, co-owner of Hot Pop Factory - a Toronto laser cutting service centre.

Hillary Predko, Site 3 coLaboratory

Hillary Predko is a designer, researcher and maker who worked at the Toronto makerspace Site 3 coLaboratory. Site 3 describes itself as a space "dedicated to making, teaching, learning and thinking about the intersection between art and technology" (About Site 3). A makerspace is a community shop that offers a wide range of tools and machines to members for use on personal or hobby projects. Makerspaces are staffed with knowledgeable technicians that help onboard new members, run classes and answer user questions. Makerspaces are hubs of creativity that have attracted a great deal of attention for their commitment to knowledge sharing, open source platforms, and advancing the very technologies they make available (Dalton, Desjardins and Wakkary 1406).

Predko described the membership at Site 3 as largely engineering-focused, with some artist members (Personal Interview). Asked to hypothesize why artist's representation was so low at Site 3 and at other makerspaces, Predko explained "... it is sometimes hard for artists to view the tools that are traditionally used in makerspaces in art contexts..." (Personal Interview). This minority representation of artists in makerspaces can be a self-fulfilling prophecy: with fewer artists working in these spaces, it's harder for artists and by extension other creative practitioners to see these as spaces for non-technical making and so on. Predko also mentions that she's observed more technical users talk down to those that are less technical. Something that can pose a barrier and reaffirm that these are not spaces for non-technical production.

Ben Light, ITP NYU

Ben Light teaches digital fabrication at the Interactive Telecommunications Program at NYU. ITP has a fully equipped workshop for students and for one month of the year it is open to participants of ITP Camp, a month long unstructured summer camp for creative adults. Like Predko, Light believes there are obstacles to artist (and other creative practitioners') engagement in makerspaces, but his hypothesis differs. Light believes the problem is rooted in how laser cutting is perceived vs. the practical reality of working with laser cutters. Laser cutting is often seen as a largely automated process. Make a file and the rest is "magic"! However, Light recognizes that the reality of working with laser cutters is far from "magic," which can discourage participation especially among beginners. He explained:

That's the part that I think is really hard for an artist to come in cold to a space. Because every machine has quirks and the people that use it often know the quirks, and the quirks get kind-of told through osmosis ... it's not magic, you have to put the time in and I think people that come in and expect it to be magic and then leave will almost always be a little upset with it because the results aren't what they thought were going to happen. Even though it's totally possible, it's just going to take a little bit. (Personal Interview)

Science fiction writer Arthur C. Clark's 3rd law is commonly quoted when speaking about modern, automated digital fabrication techniques like laser cutting: "Any sufficiently advanced technology is indistinguishable from magic" (McCullough). In terms of speed, accuracy, and power, laser cutting can seem like magic or at least capable of magical outcomes. To Light's point, however, there is a need to reinforce the very real world limitations of this tool and the importance of hands-on engagement. To temper expectations and present it within the context of variability posed by materials, brands, machine upkeep, buggy software, and the individuals running them. In presenting this technology in all its complexity, rather than maintaining an aura of magic, we set realistic expectations for beginners and also highlight the craftsmanship involved in working with laser cutters.

Matt Compeau, Hot Pop Factory

Outside of makerspaces and workshops within academic institutions, digital manufacturing service centres offer a place for the public to pay for laser cutting services. One such place is Hot Pop Factory, a shop that offers laser cutting and 3D prototyping services in downtown Toronto. Co-founder Matt Compeau noted that artists are only a small part of their clientele (5-10%) right now, but they are growing. He explained that artists who seek out their services fall into one of two categories: the first knows exactly what they want to do and has approached Hot Pop to complete a specific aspect of a project; the other has a loose sense of what they're looking to do but is interested in the opportunity to explore what is possible with this technology (Personal Interview). Of this second group, Compeau explains: "These artists are typically searching for new opportunities to push the boundaries of what's possible and develop unique and transformative works that take advantage of digital fabrication as a medium in novel ways" (Personal Interview). For this group, service centres like Hot Pop are able to assist in the creative process by lending their expertise of the medium and facilitating experimental works.

Compeau explains that Hot Pop tries to accommodate this adventurous group of artists by cultivating "... relationships where there is a bit of push and pull - we give the artist a bit more flexibility regarding how we run their jobs, and they have a certain understanding that the results might be unpredictable when we're working with them to try new things" (Personal Interview). By being open to unusual requests, they create a space where artists and other creative practitioners can experiment and learn through the process.

The challenge with an organic process such as this is that it can be difficult to structure the engagement in a way that's affordable for the artist and profitable for the business. At Hop Pop they often take creative

approaches to find a balance between these two things. This includes working closely with creative clients to adjust their work to fit a given budget or even sponsoring projects where there is the possibility for some cross promotion (Personal Interview).

Compeau admits that Hot Pop's willingness and interest to work with these users may be rare among laser cutting service centers. With a background in architecture, both Compeau and co-founder Biying Miao understand the creative process and are personally interested in creative work. Hot Pop features creative projects and art collaborations on their blog and on social media and have cultivated a presence in the local arts community. This emphasis along with their willingness to figure out ways to accommodate a limited budget for exploratory projects is certainly not the norm, but it is the reason that creative practitioners seek them out.

4.6 Discussion

There are currently a limited number of places where creative practitioners can directly access laser cutters. The most common options are makerspaces, workshops in schools and laser cutting service centres. Speaking with specialists who have experience mediating user interactions provided valuable insights for how an online laser cutting guide might be able to assist creative practitioners as they navigate these spaces.

Makerspaces are the most common points of access for connecting with laser cutters. And while they are open to all, they can be perceived as technical spaces, and tend to attract more users interested in engineering projects rather than creative works. In order to draw in more creative practitioners to engage with laser cutters there is a need to show these machines in a non-technical light and to demonstrate explicitly how they can be a tool for making creative, non-utilitarian works.

Speaking to his experience in school workshops, Ben Light highlighted the misconception of how laser cutting works as a possible obstacle to adopting laser cutting as a medium. In being perceived as magic rather than a tool that requires work and skill, it can be difficult for new users to engage with the real experience of laser cutting. The expectation is that laser cutting is easy, and it can be discouraging to find out it isn't. Any guide aimed at teaching new users about laser cutting needs to be grounded in the reality of a hands-on experience. Acknowledging the nuance of the technology and including mention of its shortfalls.

Lastly, because creative practitioners are often looking to experiment and explore the possibilities that laser cutting offers, it can be difficult to accommodate this in settings that have a profit incentive like laser cutting service centres. As Matt Compeau outlined, it takes additional effort on the part of a business to accommodate these users. This is the most challenging thing to address in an online guide and perhaps highlights the limitations of this project. One approach, however, is to provide a wide variety of examples of more experimental approaches to laser cutting. Drawing attention to the use of unusual materials and techniques that can serve as jumping off points for users.

Having considered the possibilities and challenges that laser cutting presents for creative practitioners, I will move to recounting my own experience as an artist looking to learn to work with laser cutters. The next chapter focuses on how laser cutters would become an integral part of my practice and how this experience would go on to inform the development of this project.



Bag made of clear and sandblasted laser cut beads and elastic.



Mirror in the shape of a lemon that opens and closes. Made with birch plywood and gold mirror acrylic.

Bubble catch-all dish. Laser cut walnut base with vacuum formed clear lid.



Light-up custom sign. Hand-made frame with laser cut rails and letters.



Small box made entirely of laser off-cuts.

Laser cut plywood pocket knives with screen printed details.



Laser cut wood locks used as masters for developing a series of silicone moulds.



Slide lid box made of laser cut baltic birch plywood.



Worry doll Godzilla cast in bronze with wood laser cut box in the shape of cityscape.



Ball puzzle in the shape of a doughnut made of laser cut plywood and acrylic.

Moving balls Valentine laser cut plywood and acrylic.



Slide-puzzle box. Laser cut plywood and acrylic.



Tiny galaxy doughnut made with laser cut plywood and a found crystal.

FIGURE 11: Selection of projects developed in the Spring of 2014

CHAPTER 5: The Work

I began my artistic career in printmaking. Over the years I moved on to exploring different materials and techniques, but I have always maintained a fascination with multiples that grew out of my time working in print. Another re-occurring theme in my work has been the simulation or recreation of everyday objects. This is an interest that I have explored in print, in mixed media work, and that currently drives my work with digital fabrication. The *Joy of Laser Cutting* is a design project that has grown out of my own art practice and my different creative interests. Additionally, this project has been informed by my own experience learning to work with laser cutting, my transition into teaching others to work with laser cutting and an iterative design process that included a series of public workshops. This chapter will provide an overview of these activities.

5.1 Beginnings

My initial explorations with laser cutting came out of an interest to explore the possibilities that this medium offered and to find ways to incorporate it into my own practice. I had a sense of what these machines could do from seeing laser cut projects at craft shows, but had no real understanding of how they worked. I sought out DIY tutorials from online communities like *Instructables* and *YouTube* but I quickly came up against some challenges. For starters, there was a clear disparity in the quality of tutorials available online, a finding that is echoed in the research of Tseng and Resnick in their study of online DIY tutorials. In some cases this disparity manifested itself in obvious issues related to content and format, but in other cases the problems were not as obvious. Compounding the issue of tutorial quality was the fact that as a new user I was not always able to distinguish good guides from poor ones. Another challenge I encountered was that laser cutting information was scattered across different guides and platforms. When I began my search for online information I was hoping to find one place with everything I would need to get started. The reality, however, was that there is no one source. It would be up to me to piece together the information I would need from across the web.

Beyond the technical issues that online tutorials presented, my biggest challenge was finding inspirational projects or examples of laser cut work. From my research into laser cut project tutorials, I was finding mostly utilitarian applications of the technology: guides to make boxes, organizers, home goods or accessories. An important part of my practice involves researching what has been done in a given medium or on a particular theme as a way of stimulating my own work. This interest in inspirational material is not unique to me. Tseng and Resnick's research on DIY communities confirmed the importance of inspirational materials in online DIY communities. In their study, participants were asked to rank in order of importance the reasons they use *Instructables*. Respondents stated that "getting ideas for a project" was the most important, followed by "to learn a particular technique as the second (427). A body of technical information benefits from having a variety of project examples to draw users in and encourage exploration in the medium.

Despite the important role that looking for inspiration plays in why users seek out *Instructables*, the laser cutting tutorials I found were not very inspiring. Ultimately, I relied on my own making and creative explorations to learn what was possible and to arrive at inspiring outcomes. I designed dozens of small projects and learned to work with a laser cutter through trial and error. It was a playful and fruitful process that led to a deeper and more nuanced understanding of the medium. The work completed during this time allowed me to get comfortable with the process and to understand how laser cutting could be pushed in new directions.

One area that I looked to understand better with these projects was how I could arrive at 3D objects while working with flat layers. I explored many approaches to creating 3D forms, including layering, creating small modular pieces and combining laser cutting with traditional woodworking. Each of these approaches took

the flat process of laser cutting, created different levels of relief and offered different possibilities for incorporating functionality (Figure11). Each exploration uncovered new possibilities and techniques that could be combined in countless ways. These early projects would go on to inspire other projects and subjects of the *Joy of Laser Cutting* tutorials.

5.2 Learning to Teach

Through my own experiments, I had developed a thorough understanding of the laser cutting medium and its potential for my practice. But my path to competence was not easy or efficient. There were many projects that failed because it often took me seeing a limitation first hand in order to understand it and internalize how to avoid it moving forward. Recognizing these challenges and opportunities to do better, I began a transition from pure practitioner to educator - exploring new and better ways to teach other practitioners about the laser cutting medium. This began when I had the opportunity to help develop online how-to guides for leading laser cutter manufacturer *Trotec Laser Canada*. From there I would go on to work as a lab technician at OCADU's Rapid Prototyping (RP) Lab, where I supported students looking to incorporate digital fabrication into their work. These experiences culminated in the opportunity to step into the role of teaching assistant (TA) for Continuing Education classes on digital manufacturing where I was able to develop a curriculum around laser cutting education. These three opportunities gave me first-hand experience helping new users learn the medium, and would ultimately shape the design of the *Joy of Laser Cutting* project.

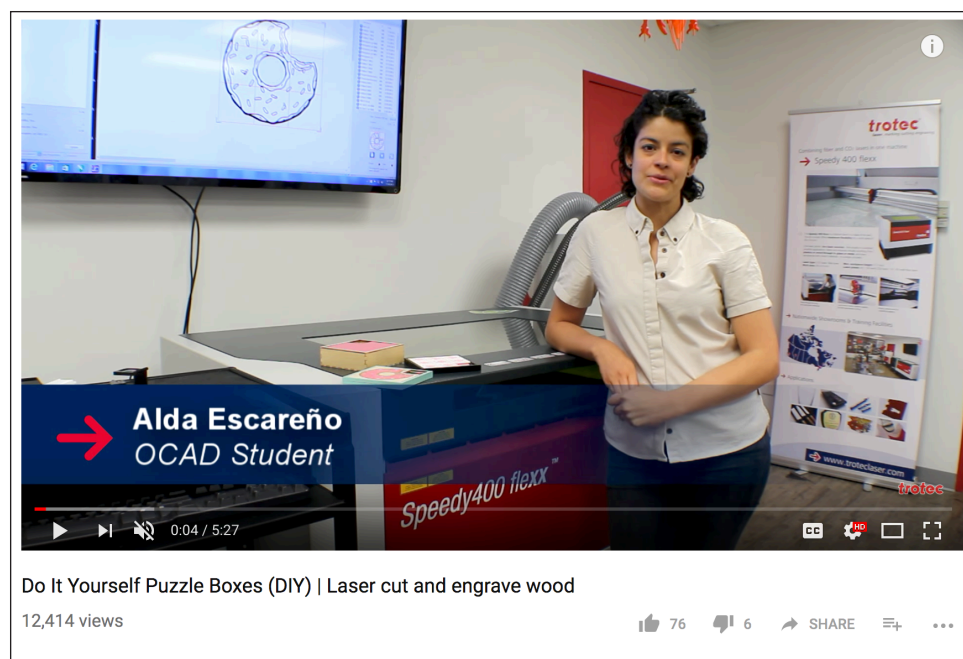


FIGURE 12: Screenshot from laser cut Slide Puzzle tutorial. For *Trotec Laser Canada*. Summer 2015

5.2.1 Trotec Laser Canada

In spring of 2015 I started an internship with *Trotec Laser Canada*, an Austrian manufacturer of laser cutting machines. *Trotec's* primary customers use laser cutting in industrial & commercial applications. Some are companies that use laser cutters to create product parts or to add branding to the tools or equipment that they manufacture. Other companies are focused on marketing and use laser cutters for branding promotional items or custom plaques and trophies. Recently, however, *Trotec* has been looking to expand their market to include creative practitioners by building a presence in online maker communities (Member Profile: Trotec

Laser Canada). My internship with them was focused on growing this emerging market by developing projects that could be presented in promotional how-to YouTube videos and *Instructable* guides.

In order to meet Trotec's needs, these videos needed to accomplish a few different things: they needed to highlight specific laser cutters, they needed to feature a diversity of materials and techniques, and they needed to appeal to creative practitioners. This was a daunting task given that this would be my first-time teaching others about laser cutting.

Recognizing the lack of inspirational projects in online DIY laser cutting tutorials, I set out to develop videos that would draw users in with exciting projects. Tutorials that would appeal to this new audience and capture the imagination - while still constituting an easy to follow tutorial. I drew on my own creative explorations and came up with two initial tutorials: one for developing a customizable sign and another for slide puzzle. These tutorials took advantage of the layered nature of laser cutting for their functionality and brought together a number of different laser cutting techniques. The Custom Sign project involved cutting and engraving a large number of individual numbers and letters and then assembling a backing with rails that these pieces could slide into. The Slide Puzzle involved designing the puzzle image, cutting and assembling the puzzle pieces and then fitting them into tight puzzle frame. These projects combined different techniques and stood out from run of the mill guides I had encountered online. Both these tutorials were selected as Featured Projects on the Instructables laser cutting category page.

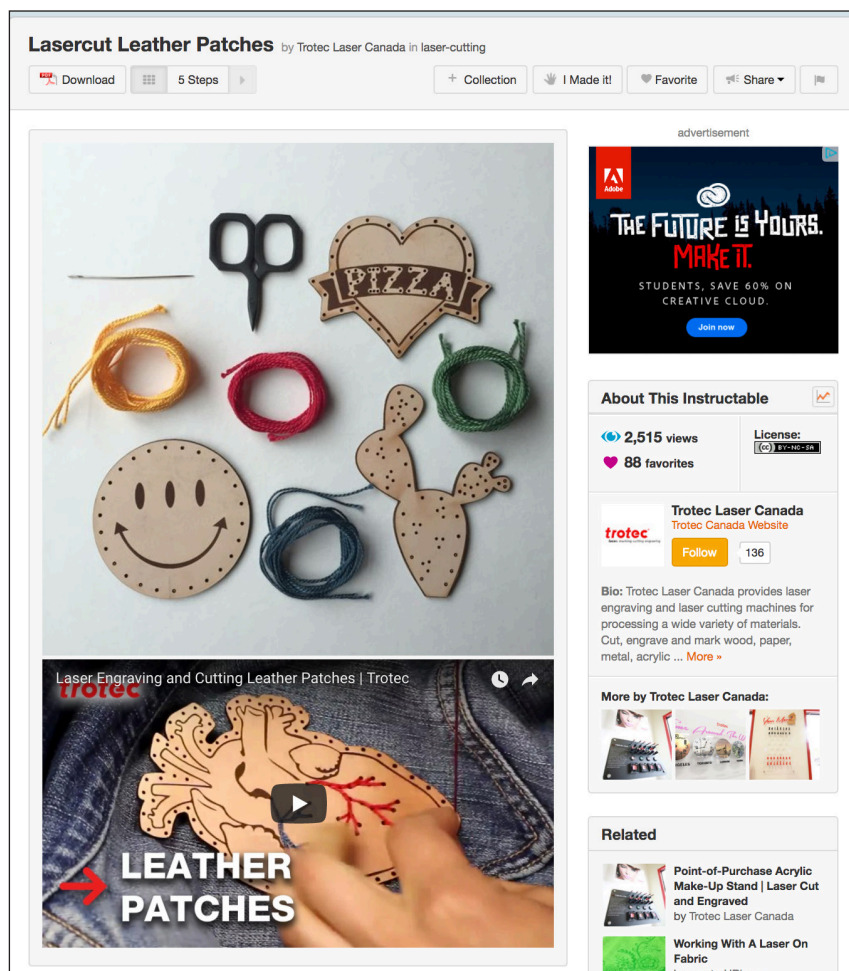


FIGURE 13: Laser cut leather patches, Instructables. For Trotec Laser Canada. Summer 2015

The lesson I quickly learned with these two initial tutorials is that developing an inspirational project can result in a complicated project guide. The combination of design skills, cutting techniques and hand assembly that these projects required meant that they were challenging to explain, both in video and *Instructable* form. After the first couple videos, I changed my approach to instead develop tutorials that focused in on specific skills or materials. An example of these is the Leather Patches tutorial. This project does not need any assembly, painting or measuring. Instead it outlines how the basic functions of a laser cutter (cutting and engraving) could be applied to working with leather in a specific way. This focusing of the tutorial in combination with some playful examples, allowed for still attractive videos that were much more concise.

It is hard to know if this shift in approach resulted in more completed projects by users. But from the development side, it allowed for increased clarity in explanation. It should be noted, however, that the overall popularity of the project videos on *YouTube* and *Instructables* in terms of likes and views reaffirmed the importance of attractive, inspirational projects; the first couple of projects I did for *Trotec* remain the most liked and viewed.

My first experience in teaching others about laser cutting required developing the kind of DIY tutorials that I had searched for when I was looking to learn how to work with these machines. Through this process, I sought to address one of the key gaps that I had encountered: the lack of inspirational projects. The projects I developed for *Trotec* during my internship all received a great deal of positive attention; all my *Instructables* were Featured Projects, and to date the Slide Puzzle project has received over 16000 views on *YouTube*. This experience showed me that there is an audience that is interested in inspirational laser cutting projects. In developing these tutorials, however, I also came to appreciate the need to balance exciting projects with simple and concise tutorials that new users can more easily follow; two aspects of project developments can sometimes seem at odds.

5.2.2 OCAD University Rapid Prototyping

In the Spring of 2016 I started working at the OCADU Rapid Prototyping (RP) Lab as a technician, a position that I maintain to this day. In this role I answer student questions, lead class orientations and help students realize projects through the use of machines we have in the lab: 3D printers, scanners, laser cutter and a CNC mill. Working directly with hundreds of students that want to use digital manufacturing techniques for the first time has given me the opportunity to learn first-hand what approaches and tools work best for communicating with and supporting new users.

The experience of going over the basics of laser cutting again and again with new users has helped me develop some language and strategies for explaining different processes. In some cases I have found that simplifying a concept in a particular way can help new users better understand it. An example of this is the need to use different colour lines to indicate the order in which cuts should take place. While there are many reasons why you would set an order to the cuts in a project, I tell students to change the colour for their lines any time they have nested cuts- always working from the inside out. Once in a while, this won't apply to a particular project, but most of the time, this works well. I have used strategies like this in developing the language used in the *Joy of Laser Cutting* tutorials.

The other takeaway from working in the RP Lab, is the need to have a point of reference that covers basic laser cutting information. Users cannot be expected to remember all the details for a new process. A collection of tutorials would benefit from having a quick reference page that can remind users of some laser cutting basics like file set-up, the definition of commonly used terms and the materials that can and cannot be used. The inclusion of a reference section or a getting started guide is a common practice in cookbooks and one that I took inspiration from. For example, the 1963 edition of *The Joy of Cooking* included for the first time a large

chapter called “Know Your Ingredients.” This section included definitions, charts, illustrations, the overview of basic cooking techniques and explanation of some basic cooking science. The goal in adding this to *The Joy of Cooking* was to help readers understand “not just the hows of cooking, but the whys, as well” (Mag). The getting started guide that I have put together presents some laser cutting history along with the basic technical information. Like the “Know your Ingredients” section, it is meant to help users understand why laser cutters operate in certain ways and how they can work within these parameters.

Working at the RP Lab gave me the opportunity to facilitate hundreds of users’ first encounters with a laser cutter. The sheer number interactions that I have had, has helped me refine the language that I use for explaining laser cutting and has helped me identify what support tools could best serve these users. I have applied these lessons in the design of the *Joy of Laser Cutting*.

5.2.3 OCAD University Continuing Studies

The third experience that informed the development of the *Joy of Laser Cutting*, is my role as a TA for a Continuing Education course on laser cutting and CNC milling. As TA, it was my responsibility to help develop a curriculum for teaching laser cutting and to provide technical instruction and support for students. Unlike the short-lived interactions that I have with students in the RP Lab, the class setting allowed me to work closely with the same group of students for six weeks. This afforded me the space to think about how laser cutting could be broken up into lessons that build on each other and what exercises and projects best support these lessons. In the two terms that I have had the opportunity to be a TA, I have had the chance to try different approaches for how a laser cutting curriculum can be structured to teach the basics and appeal to the wide range of interests that the students bring to the class.

Each of these three teaching scenarios helped me think through the challenges of presenting this technology to first-time users in a variety of different contexts. At my internship with *Trotec Laser Canada*, I learned the need to balance inspirational projects with accessible tutorials. At the OCADU RP Lab, I was able to refine the language that I use for explaining laser cutting and identified the need to a quick reference guide to support new users. Finally, as a TA in a continuing studies laser cutting class, I was able to take everything I knew about laser cutting and shape it into a lesson plan. Each of these experiences have helped me improve my own laser cutting skills and have shaped the *Joy of Laser Cutting*.

5.3 Prototype A: #MKRCookie

#MKRCookie (mkrcookie.com) was my first attempt at presenting a DIY tutorial as a recipe.

The initial design came out of an interest to design an inspiring project - something that stood apart from other DIY tutorials and captured the imagination. The approach I took was to recreate an iconic commercial cookie using modern digital manufacturing techniques. I selected the *Peek Freans Fruit Crème* as a starting point for its classic design. I wanted a cookie that would not only be easily recognizable, but that could stand in for all packaged cookies - something that spoke to the comfort of home without being home-made. As a way of focusing on the icon of the cookie, I scaled it up to the size of a dinner plate. I then changed the name to #MKRCookie, a play on the maker approach to its construction. Much like a real recipe, the process of developing the recipe for #MKRCookie required making several different cookies, using different materials and techniques until I arrived at a final result that I was happy with and that I thought would offer reliable results if others were to attempt it.

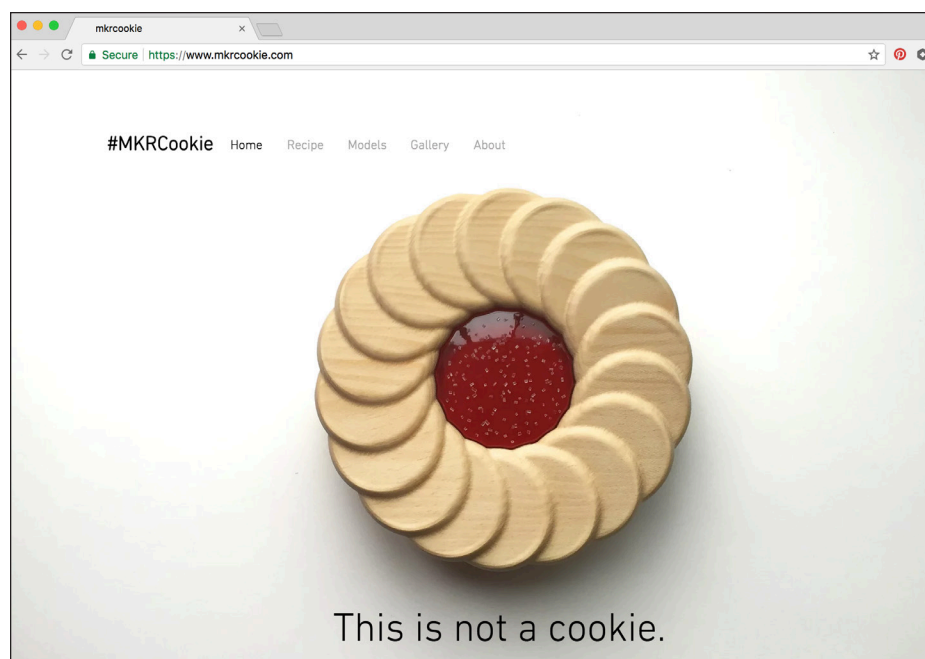


FIGURE 14: #MKRCookie website homepage. Spring 2016

The #MKRCookie recipe I developed uses CNC milling to produce the cookie top and bottom. The jelly, is cast transparent red resin, topped with tiny plastic flakes to replicate sugar crystals. The middle cream was made using upholstery foam covered in white velour fabric - this foam is firm, but is still able to be squished if the top and bottom cookie pieces are pressed together. The pine that I used for the cookie has been sanded and has a light varnish that gives the cookie an even golden colour. The result is a very convincing fake cookie.

The instructions for making this cookie were presented online in the form of a recipe along with photos of the process for making it and the original files that I used in the making process. The recipe presentation style I used in this project was very much inspired by the short-form recipes of *The Joy of Cooking*; the steps are clear, but little detail is expanded on. The use of the recipe format was fitting given that the project was a cookie and also offered a familiar easy-to-follow format.

The recipe format was also an appealing approach because it serves the dual role of being a guide and an invitation for possibilities (Sceats). My hope was that users would take what I was presenting as a starting

Ingredients

Yields one 9.5" cookie

Cookie

1 1/2" thick clear pine board. At least 12" wide by 3' long
1/2 teaspoon of natural wood stain

Jelly

1/8" sheet of [PET plastic](#). At least 10" x 10"
8 tablespoons of [polyester resin](#)
2/3 teaspoons of red pigment
1 teaspoon of [methylene chloride](#)

Cream Filling

1 square foot of 1" upholstery foam
2' x 14" white [velour stretch fabric](#)
20' of 1" wide adhesive-back velcro
White cotton thread



FIGURE 15: #MKRCookie ingredients list. Spring 2016

point but that they would then replace materials and techniques in the same way that ingredients and methods are replaced in cooking based on personal taste and available tools. As a way of hinting at this potential for altering the original recipe, I began making and sharing a variety of cookie remixes on the project *Instagram* account and on the #MKRCookie website. When I came up with this project, I chose a name that started with a “#” as a way of encouraging users who engaged with the recipe to share their cookie variations via social media.

In the summer of 2016 I had the opportunity to share this project at Maker Festival, a large event catering to families at the Toronto Reference Library. It was in this buzzing environment that I got to experience the power of working with food imagery. The reaction that the public had to the various #MKRCookies was pure delight and excitement. People were drawn in to inspect the cookie display from across the room. Much like food displays outside Korean restaurants (Kim), many thought the oversized #MKRCookie was real - a point of pride for me. Once up close, visitors were eager to share stories or memories that they associate with the iconic cookie. The effect of the food imagery was powerful, but also magnified at an event where it seemed so out of place. There were hundreds of booths and exhibitors connected to maker culture but very few related to food in any way.

During the three days that I was there, I had the opportunity to lead mini workshops with the public (mostly children) to teach them a bit about digital manufacturing. The complexity of the processes used to make the original #MKRCookie made it ill-suited for these workshops. I instead developed a vastly simplified version that focused only on laser cutting. Participants were able to assemble their own #MKRCookies using laser cut parts, felt, hot glue and glitter - a recipe I have kept in the *Joy of Laser Cutting*. The elaborate and oversized *Fruit Crème* replica was a big draw for the public, but explaining how it was made was complex as it involved too many unfamiliar processes. The little workshop cookies were designed with only one unknown: laser cutting. By keeping it simple I was able to keep my explanation clear and concise.



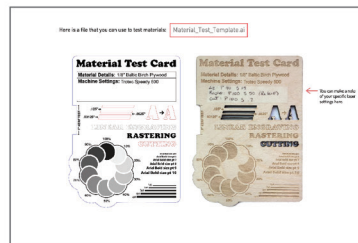
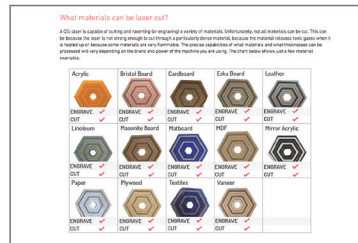
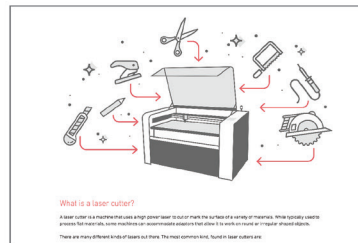
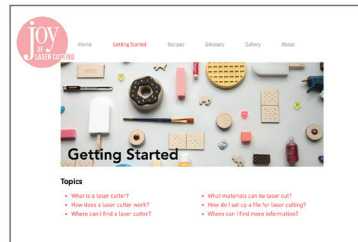
FIGURE 16: Pictures taken at Maker Fest. Toronto Reference Library, July 2016

The experience of sharing the #MKRCookie project at this event was an opportunity to see first-hand public reaction to the use of food imagery and to see the challenges in presenting new technologies to an uninitiated audience. Ultimately it would be a turning point for the development of this project. This experience made it clear that working with food imagery was a successful strategy worth exploring further. It also illustrated that if I wanted to truly engage an audience that was new to digital manufacturing, the tutorials I was developing would need to be simplified and focus in on a single medium or technology. Again, I found myself needing to balance the importance of developing an inspiring project with something that was more accessible.

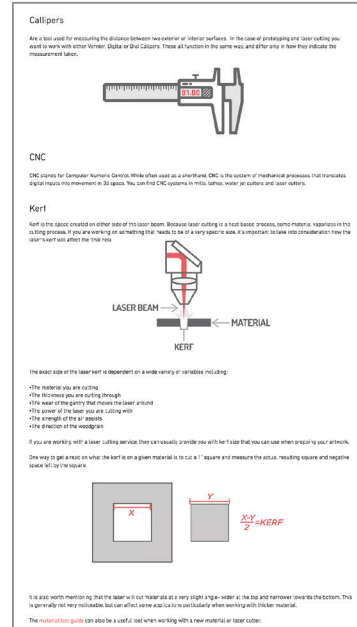
Home Page



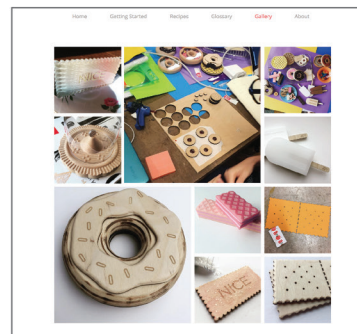
Getting Started



Glossary



Gallery



Recipes

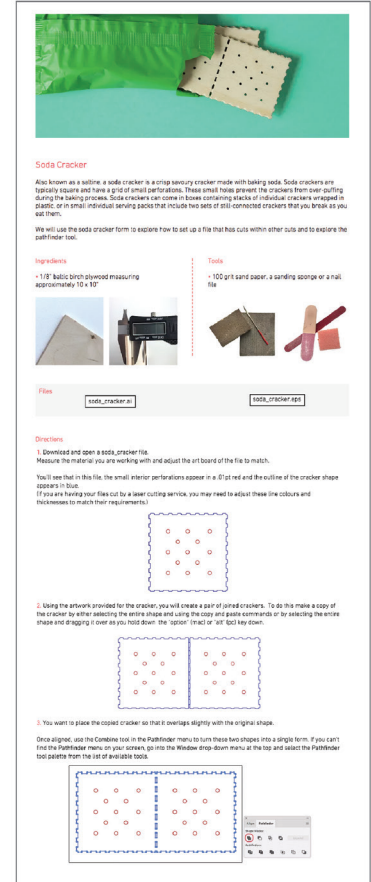


FIGURE 17: Joy of Laser Cutting Website screenshots. December 2017

5.4 Prototype B: Joy of Laser Cutting

The *Joy of Laser Cutting* (joyoflaser cutting.com, also see Appendix II, III and IV) is an instructional website for teaching creative practitioners about laser cutting so that they can explore the medium and potentially incorporate it as part of their practice. Through my experiences learning about laser cutting and in turn teaching others, as outlined above, I identified 7 crucial qualities that I ultimately incorporated into the design of the *Joy of Laser Cutting*:

1. Presentation of key information required for a new user to engage with laser cutting in one place
2. Use of inspirational projects that are also accessible to users
3. Clear, simplified explanations of laser cutting techniques
4. Quick reference guide
5. Lessons presented in a logical order that build on each other
6. Tutorials incorporate additional making techniques without distracting from laser cutting
7. Presenting tutorials in a way that stands apart from approaches currently seen on online tutorial sites

Below, I will present how each of these individual qualities were considered and are present in the final *Joy of Laser Cutting* project.

1. Presentation of key information required for a new user to engage with laser cutting in one place

Joy of Laser Cutting introduces users to how they can work with laser cutters through nine step-by-step project recipes, a getting started page, a photo gallery and a glossary of common laser cutting related terms. This guide does not offer the machine specific details needed for the hands-on operation of laser cutters, but rather shows users how to prepare files that are ready to be laser cut. Each of the recipes illustrates a specific laser cutting technique and the file set-up it requires. These recipes cover basic laser cutting skills, more advanced production tricks and how these techniques can be combined in creative ways.

2. Use of inspirational projects that are also accessible to users

From my own experience looking for inspiring DIY tutorials, I knew it would be important to develop projects that engage users' imaginations. My approach for addressing this was to design all laser cutting recipe guides around different food forms: animal crackers, waffles, popsicles, doughnuts etc. These specific food designs came about as I identified the skills I wanted to focus on in each lesson. Having selected a potential food item that could work with a particular lesson, I went through several iterations until I fine-tuned the balance between achieving an accurate food representation, designing an accessible tutorial and highlighting the specific lesson it was focused on.

Each recipe guide also includes images of variations on the form presented. These recipe remixes use different materials or present slight deviations from the techniques presented. These are not meant to be prescriptive as they don't come with any details on how they can be recreated. They are meant to emphasize the recipe's dual role of presenting "rules and creative possibility" (Sceats). The possibility to step outside the lines of what is being presented is an important aspect of the *Joy of Laser Cutting*, as it allows users to take what they are learning and make it their own. Additional photos of remixes are presented through the photo gallery section on the website.

3. Clear, simplified explanations of laser cutting techniques

In writing the recipes, I used language and strategies that I employed when teaching students in the RP Lab. To ensure that the described processes were clear, the writing was complemented with the use of photographs, illustrations, annotated screenshots and gifs. The use of illustrations proved to be especially

helpful for presenting more complicated aspects of laser cutting that can't be easily photographed or described like, for example, laser kerf.

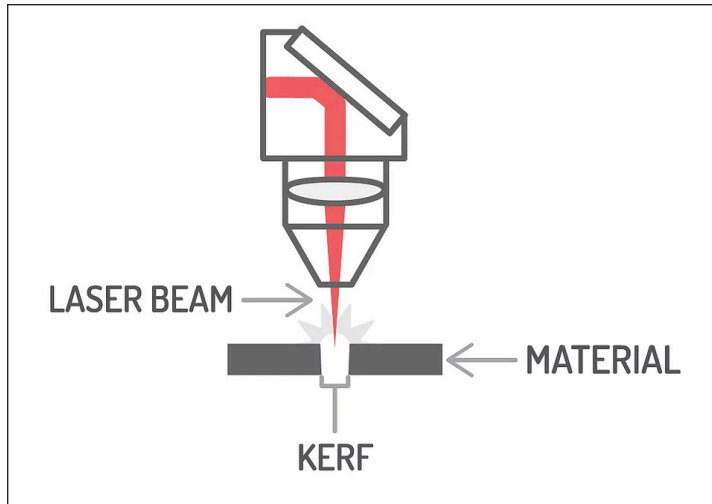


FIGURE 18: Kerf illustration from the *Joy of Laser Cutting*

4. Quick reference guide

Another element I wanted to incorporate into the *Joy of Laser Cutting* was a quick reference guide. From my experience working at the RP Lab I knew it would be important to have a place to easily look up information that may be hard to remember as a new user. For the *Joy of Laser Cutting*, I decided to include a Getting Started page as well as a Glossary of Terms.

The Getting Started page is the first point of information. It walks users through the essential information needed to understand laser cutting. It covers how laser cutters work, the materials it can cut and engrave and has a set-up guide for using Adobe Illustrator to put together a laser cutting file. As users work through the recipes, this page serves as a reference page for all these basic set-up details.

The Glossary, lists definitions for terms commonly used as well as more detailed information on materials and software related to laser cutting. These definitions are linked to from the recipe guides as a way of helping users look up any words that may be unfamiliar to them.

5. Lessons presented in a logical order that build on each other

Based on my experience developing a laser cutting curriculum, I broke up the lessons on the *Joy of Laser Cutting* into nine parts. These lessons are listed on the recipe page from basic to advanced with the last few focusing on how the skills presented can be combined. Each recipe is designed to cover one specific skill or technique. As an example, I decided to use Animal Crackers for the very first recipe. This iconic cracker form was a good fit for a starter recipe since it can be executed convincingly with a single laser cut function: cutting. The next project, Nice Biscuits uses cutting again and adds linear engraving.

To ensure that the particular skill I was targeting was the focus of the recipe I developed, I included partially completed Illustrator files that users could download and work from. These files served as templates for completing the recipe and avoided the need for users to build a file from scratch.

6. Tutorials incorporate additional making techniques without distracting from laser cutting

From my experience developing #MKRCookie, I knew that there was a balance I would need to strike between showing how laser cutting could be combined with other making techniques and maintaining the

focus on laser cutting. I included hand finishing, painting, assembly and some basic woodworking in the recipes I designed but these techniques were used to complement and elevate the work being done with the laser cutter. By including these other making techniques, I am looking to encourage users to think of ways to combine laser cutting with their own areas of expertise.

7. Presenting tutorials in a way that stands apart from approaches currently seen on online tutorial sites

I used food imagery and recipes to set the *Joy of Laser Cutting* apart from other online laser cutting guides and tutorials. To take this further, I incorporated a visual language that closely referenced recipe sharing practices. Taking inspiration from online food blogs and current trends in food styling on *Instagram*, I took bright, bold photos of the projects being developed. The photos are playfully styled and present the projects in monochromatic settings using painted props. These photos do not look like typical online tutorial photos, and as such, going to the *Joy of Laser Cutting* is not a typical online tutorial experience.

This project was inspired by my own experience learning how to laser cut. It took shape through the lessons I learned while developing DIY tutorials about laser cutting and teaching others how to engage with this technology. These experiences and lessons in combination with my own creative interests resulted in the *Joy of Laser Cutting*, a website that could be a valuable tool for creative practitioners looking to engage with laser cutters. After working on this project in isolation I arranged a couple of workshops to see if this, indeed, was the case.

5.5 Testing the Joy of Laser Cutting

In order to test out the Joy of Laser Cutting, I organized two workshops with artists and creative makers - one at ITP Camp in New York and the other at OCADU in Toronto. The first workshop at ITP Camp was an opportunity to run through the material with a large group of people with focus on validating the content and order of the lessons. The second workshop at OCADU was a much smaller group meant to recreate the experience of users encountering the website and working through the material on their own. Each workshop gave me valuable feedback into aspects of the project and the website that were working and areas that needed further fine tuning.

5.5.1 Workshop A: ITP Camp

ITP Camp is a month long unstructured summer camp for creative adults hosted in the ITP department at NYU.



FIGURE 19: Pictures taken at *Joy of Laser Cutting* workshops during ITP Camp, June 2017

Recognizing the important role that creativity and the act of making can play in our lives, this camp offers an opportunity for participants to spend focused time learning, collaborating, and making.

Originally, I planned to run two different workshop styles: one would be a self-guided session in which participants would have the opportunity to read through the material presented on the website and begin exploring the tutorials on their own, the other would be a guided tour of the *Joy of Laser Cutting* website in which I would present the material on the website and the tutorials.

After an initial attempt at hosting a self-guided workshop, however, it was clear that it would be a challenge to host a workshop in which I was not actively engaged in presenting the material. To be clear, the challenge did not appear to be related to the content of the website but rather the interactive and informal nature of the camp. It was unusual to ask participants to teach themselves in this environment, so I decided to stick with the moderated format moving forward.

During the guided sessions, I would present the tutorials while participants followed along on their laptops so that they could see the charts, images and photos. During each workshop, I walked through a few recipes step-by-step, showing examples of the projects at different stages to illustrate the skills covered by the different tutorials. Having covered all the material, I gave participants the rest of the time for self-directed exploration. They could either follow a recipe from the website or apply the skills I had covered to one of their own projects. During this time participants used the website as a reference while I answered any additional questions and provided hands-on support on the laser cutter. This workshop allowed participants to get an overview of laser cutting, learn specific skills and apply them almost immediately to their own work.

As part of the set-up for these workshops, I arranged a display of example *Joy of Laser Cutting* works made using a variety of materials and techniques. Having this lavish food-inspired display front and center proved a useful strategy to engage participants' imagination - it seemed out of place in a workshop and therefore was a powerful draw.

In total, there were about 20 participants over the week. Of those, 3 completed a tutorial project from the website, while everyone else applied the skills they had learned from my demo to their own projects. Every workshop I ran at ITP ended up going over the allotted time because participants were eager to continue working on their projects, and 3 participants actually ended up participating in multiple workshops during the week.

ITP Camp was my first opportunity to share this project with a group of users and collect feedback. I was especially curious to see if the combination of technical instruction and recipes would be as successful for others as it had been for me. In a follow-up survey, participants confirmed that it was indeed a successful format with comments like: "Very useful, specifically as a beginner. A very enticing and pleasant way of presenting learning material. Super fun :)" and "The food and recipes made the workshop very engaging" (Escareño). In this survey I also asked participants if they could indicate their level of laser cutting knowledge before the *Joy of Laser Cutting* workshop and after. All respondents indicated that their laser cutting knowledge level had increased.

I was also pleased to find that the workshop had been successful at presenting laser cutting in a different light. One participant commented: "I'd seen laser cutting before, but was never really drawn to it. Not sure why I would use it. But this is so different. It's giving me all these ideas of what I can do!" (Escareño).

Still, not everything about this workshop was a success. In particular, the varying levels of skill and experience participants had with *Adobe Illustrator* proved to be a considerable challenge. Working with a laser cutter necessitates some familiarity with vectors and the software for manipulating them. *Adobe Illustrator*

is a popular tool used for this and the main software that I reference in the online lessons. My approach during the workshop was to provide software support only as issues came up, not to focus my teaching on the specifics of how to use *Illustrator*. Throughout the workshop, however, I found myself spending considerable time working with participants who were brand new to the software and therefore needed lots of help understanding the basics of *Illustrator* before they could actually start working on their projects. Additionally, I noticed confusion from participants using different versions of *Illustrator* who encountered different features, layouts, and preferences from what I presented on the website. My key takeaway from this experience was that I would need to add more details to the instructions involving *Adobe Illustrator* including annotated screen shots. I would also need to develop or locate some version-specific reference material to support participants who are brand new to *Adobe Illustrator*.

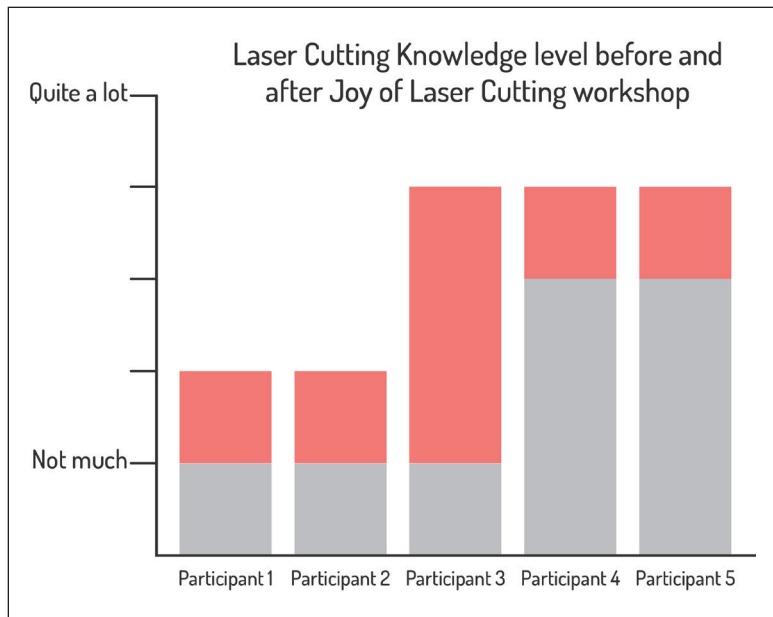


FIGURE 20: ITP Camp, *Joy of Laser Cutting* workshop knowledge level change, as measured through workshop feedback questionnaires. June 2017

5.5.2 Workshop B: OCADU

After the first round of workshops at ITP Camp, I wanted to host a self-guided workshop where users could interact with the website independently. I put out a call for participants on the OCADU Facebook page and in the end had 4 participants signed up. As these sessions were meant to be self-guided, I tried to replicate the experience of a user arriving at the website organically for the first time by hosting the workshop in an empty room, and giving limited proactive instruction.

After a few introductory remarks, participants were instructed to navigate to the *Joy of Laser Cutting* website, read through the material presented, and either follow one of the tutorials on the website or apply the lessons learned to a project of their own. I ran completed files on the laser cutter in the RP Lab, after which participants had the opportunity to make adjustments to their files based on the results or to hand finish their pieces.

Like the workshops at ITP Camp, my experience at OCADU was largely successful. However, one new issue I observed was that many of the questions participants asked me could actually be answered by reviewing the content on the website. While I was not able to conclusively identify the root cause of this issue, I have a few different hypotheses that might explain what happened.



FIGURE 21: Pictures taken Joy of Laser Cutting workshop at OCAD U, August 2017

One possibility is that participants were short on time and, as a result, only skimmed the material. This could be resolved by giving them more time, or by sharing the website with them in advance of the workshop. For users that are encountering the *Joy of Laser Cutting* organically, I am assuming that they will have ample time to explore the website and seek out answers to questions and problems they encounter.

Another possible explanation for why participants were asking questions that were answered on the website, was that they simply started in an unusual place. I had assumed participants would be looking to begin with the Getting Started section, but in practice this may not be the case. This could be resolved by adding additional links and references to relevant information in all recipes. When I initially designed each recipe, I avoided being too repetitive of material that was already covered. Seeing that users do not always take a linear approach to engaging with the tutorials, I needed to make sure that there were more prompts and links to where users can find information that had been covered in earlier recipes or in the Getting Started guide. Additionally, adding clearer notes for where to begin on the home page would ensure that users were directed to the sections they wanted to go to.

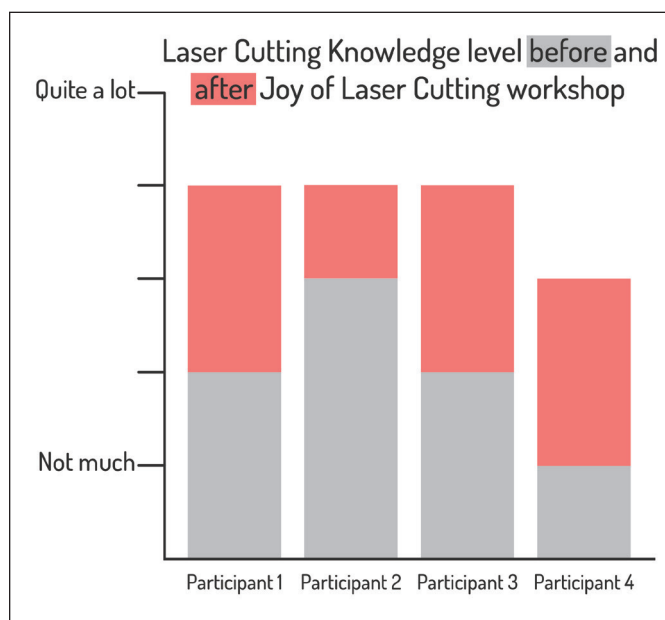


FIGURE 22: OCADU Joy of Laser Cutting workshop knowledge level change, as measured through workshop feedback questionnaires. August 2017.

These are just two possibilities for why users were asking questions that had been answered on the website. There are, however, a number of other potential causes including the structure or clarity of content on the website itself that could be further explored.

The feedback I got from participants of the OCADU workshop confirmed my earlier results that the format and content of the *Joy of Laser Cutting* was engaging. However, it did reveal some of the challenges inherent to an unguided format. Through the follow-up survey, I was happy to find that despite this, all participants indicated an increase in their laser cutting knowledge level after participating in the workshop.

Running these two workshops gave me an opportunity to see if this project resonated with others and whether it worked as a teaching tool. This project was largely developed with my own experiences in mind. Seeing it being used by other artists and hearing their feedback was instrumental in helping me create a project that is grounded in real functionality.

5.6 Joy of Laser Cutting Exhibition

Putting together a final gallery exhibition for the *Joy of Laser Cutting* meant being creative about how to highlight and display the various stages of development and the significant work that was done along the way. I broke down the gallery space into three key stages:

- *EXPERIMENTS*
- *#MKRCookie*
- *Joy of Laser Cutting*

The *EXPERIMENTS* area was a display of a wide range of small works that I produced when I was learning to work with digital fabrication. The pieces that were displayed in this section had very little to do with each other, but each represented some exploration that led to a better understanding of the medium, form, function or material possibilities. To capture the “studio” nature of this stage, this area was presented with minimal curation. Just a straightforward presentation of the work.



FIGURE 23: *EXPERIMENTS*. Wide range of small works produced in a variety of mediums presented as part of *The Joy of Laser Cutting* final thesis Show, December 1-5, 2017



FIGURE 24: #MKRCookie. Collection of digitally fabricated works and printed material presented as part of *The Joy of Laser Cutting* final thesis Show, December 1-5, 2017

#MKRCookie was an important learning experience that helped me lay the foundation for the *Joy of Laser Cutting*, for this reason I gave it a large footprint in the gallery exhibition. While the #MKRCookie project still lives online, I chose to print the process images and the photos from the website on large format translucent hanging banners. These were next to a curated collection of #MKRCookie remixes that I made over the years including two very large CNC milled flat cookies on the wall. I also included some ceramic cookies made by my mom, the only person to complete the participatory aspect of the #MKRCookie project.



FIGURE 25: #MKRCookie print banners. Various sizes. Presented as part of *The Joy of Laser Cutting* final thesis Show, December 1-5, 2017



FIGURE 26: #MKRCookie cookie and a variety of remixes. Mixed media. Presented as part of *The Joy of Laser Cutting* final thesis Show, December 1-5, 2017

The *Joy of Laser Cutting* section would prove to be the most challenging to realize. While this needed to be the focus of the show, the content for this project is entirely online and the pieces made for the website were quite small. My strategy for presenting the work was to create a large grid of printed photos from the website along with laser cut illustrations and an interactive projection of the website itself. This grid was displayed along the main gallery wall and incorporated a collection of completed projects on plinths as well as oversized versions of some recipe pieces. This long colourful grid, large illustrations and oversized cookies served to bring the visual language used in the website into the gallery space.

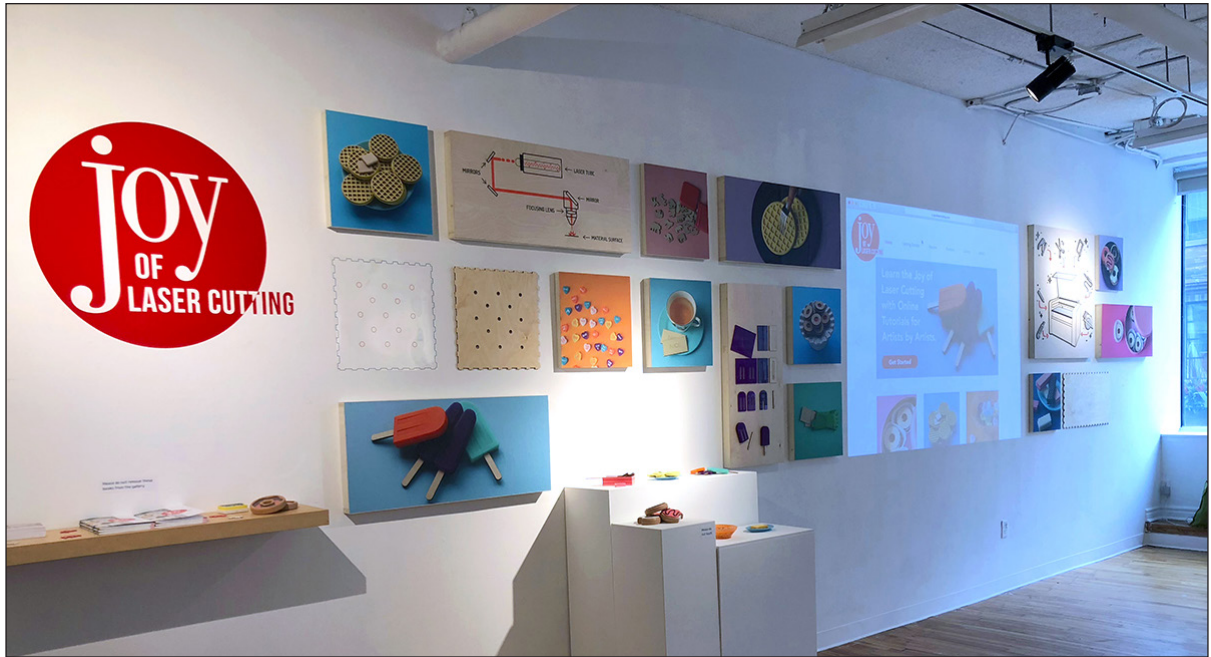


FIGURE 27: *Joy of Laser Cutting*. Digitally printed photographs, lasercut wood illustrations and cookies, collection of project examples and a projection of the project website. Presented as part of *The Joy of Laser Cutting* final thesis Show, December 1-5, 2017



FIGURE 28: *Joy of Laser Cutting* Recipe project examples. Mixed media. Presented as part of *The Joy of Laser Cutting* final thesis Show, December 1-5, 2017

One additional piece that I completed for the show was a small edition of bound book versions of the *Joy of Laser Cutting*. This printed prototype is meant to highlight how this online project could move forward and grow beyond its current incarnation. Going through the process of designing this book required seeing the recipes through a new lens and thinking about how a printed instruction book might function differently than its online counterpart. This version of a printed *Joy of Laser Cutting* begins to tackle some of the possible differences between the two, but as it is a first attempt it leaves room for further development in the future.



FIGURE 29: *Joy of Laser Cutting* printed books. Presented as part of *The Joy of Laser Cutting* final thesis Show, December 1-5, 2017

CHAPTER 6: Conclusion

6.1 Summary

This thesis was inspired by my frustration at the lack of inspiring and useful online material for learning about laser cutting. In designing the *Joy of Laser Cutting*, I set out to provide a collection of online laser cutting tutorials to fill this gap and address the needs and interests of creative practitioners like me. I used food imagery and the recipe format as a strategy for presenting the material and tutorials in a way that evokes familiarity and inspires engagement with the material. The goal of this project is to provide users with an overview of what is possible with these machines and to encourage creative exploration of the medium.

To support this endeavour, I conducted research into recipes, food imagery and DIY tutorials. The project was also informed by my own experiences learning to work with laser cutters, and subsequently teaching others as a tutorial author on Instructables, as a technician at the RP Lab at OCADU, and as a TA in a digital manufacturing class. Armed with this research and experience I engaged in an iterative design process to create an online tutorial. My first prototype for this was *#MKRCookie*, a website that provided step-by-step instructions for creating a realistic replica of a Fruit Crème cookie using a combination of digital manufacturing and hand making techniques. The lessons learned through the process of making *#MKRCookie* were incorporated into my final prototype, *Joy of Laser Cutting*. While working on the final prototype, I conducted a series of expert interviews with artists and specialists that work with laser cutters in order to better understand the challenges and advantages artists face in working with this technology and to further inform the goals of this project. Once I had a working online website for *Joy of Laser Cutting*, I hosted two workshops with users to collect feedback and fine-tune the design of the website.

6.2 Research Question Review

This work was guided by the following research questions:

- How can I engage creative practitioners to explore laser cutting?
- How can online resources for learning laser cutting be re-imagined to better cater to the interests and needs of creative practitioners?
- How can food imagery and a recipe format be used as tools for teaching how to work with new technologies while providing room for creative input and improvisation?

How can I engage creative practitioners to explore laser cutting?

To more effectively engage creative practitioners with the medium, I first sought to better understand how laser cutting is seen in the world. In doing so, I discovered two misconceptions that may be getting in the way of users engaging with this technology:

Misconception #1: Laser cutting is only appropriate for the production of commercial goods. This misconception stems from the fact that it is possible to produce attractive results with very little design or labour. As a result, laser cutting is commonly used at the “local minimum” of what the technology is capable of. This lends itself to the production of commercial goods but there is less incentive to have complex and creative interactions with the laser cutting medium.

Misconception #2: Laser cutters are magic. Partly because most of the work happens around the “local minimum,” laser cutters are seen as ‘magic’ – just press a few buttons and out comes a keychain or some other knick-knack. While laser cutters are capable of very impressive things, this magic aura creates a disconnect with the real experience of working with these machines. Just like any other medium, laser cutters require

users to become familiar with the nuance and quirks of the technology and the individual machines. As Ben Light said during our interview “there is a craftsmanship to laser cutting” (Personal Interview). In order to engage creative practitioners, this craftsmanship needs to be highlighted. In grounding perceptions about laser cutting in reality, we highlight the real work and real opportunities that it offers.

Joy of Laser Cutting aims to address these misconceptions by reframing laser cutting. It challenges the first by presenting decidedly noncommercial applications for laser cutting. The projects in *Joy of Laser Cutting* are art objects; non-functional fake foods. These are projects that focus on the skills that are being used to make them and the results that come from a combination of techniques. To address the second misconception, *Joy of Laser Cutting* includes mention of the variables that play a role in project outcomes and stresses the importance of the work that needs to be done after a piece has been laser cut. This project highlights the fact that quality results come from the work and attention that is put into any project.

There are, however, limits to communicating the nuances of laser cutting through an online tutorial, as I observed at the workshops that I hosted. When participants were able to see in person the results of their own laser cut work, it went a long way to making the lessons they were learning real and excited them about what more they could do with this technology.

To truly encourage creative practitioners’ exploration and engagement with new technologies, it is important to not only create online material, but to also look at facilitating physical spaces where they can have real-world experiences with these machines. At this stage laser cutting is still not readily accessible and while online material will help illustrate what is possible it cannot replace the impact of seeing the results of laser cutting in real time. As Matt Compeau discussed, creative users greatly benefit from opportunities where they are able to interact with laser cutters with the assistance of expert technicians. This is definitely an opportunity for broader exploration.

How can online resources for learning laser cutting be re-imagined to better cater to the interests and needs of creative practitioners?

My experience as an artist learning to laser cut as well as my time working at the OCADU RP Lab and as a TA in a digital manufacturing class helped me develop an understanding for what an online educational tool targeted to creative practitioners might look like. From the importance of inspirational images to the need for a quick reference guide, these experiences helped me design the *Joy of Laser Cutting*.

In running workshops with users I found that indeed I have developed something that is appealing to other creative practitioners. That said, there are still some gaps in the material I presented. For example, my tutorials assumed a basic working knowledge of *Adobe Illustrator*, a critical tool used in laser cutting. In practice, however, many of the participants had never used the software before and therefore struggled to complete basic tasks. It is not reasonable to create a tutorial for using *Adobe Illustrator* as part of this work. A better solution is to leverage and connect this project to the wider ecosystem of tutorials that already exist. Further research could also be undertaken to review and present free alternatives to *Adobe Illustrator* like *Inkscape* as the cost of working with *Illustrator* can be a barrier to users.

How can food imagery and a recipe format be used as tools for teaching how to work with new technologies while providing room for creative input and improvisation?

My initial interest in recipes and food imagery came out of my own creative practice, but as I have demonstrated in this thesis, they have proven to be useful for presenting how-to laser cutting information. Food imagery is universally relatable and therefore serves as a device to engage users. I had the opportunity

to see this happen in person first, when I presented *#MKRCookie* at the Maker Festival and visitors were drawn in by the sight of a giant Fruit Crème and then again at the ITP Camp workshops where my display food project samples attracted participants to the workshop.

The recipe medium evokes a familiarity and triggers attitudes for interacting with them. As I explored in Chapter 3, recipes carry a sense of trust and break down unknown processes into easy to follow steps. Additionally, they invite participation and improvisation in the making process. Using the recipe format for presenting laser cutting tutorials seemed like an unorthodox approach at first, but it ultimately worked: by and large, workshop participants were able to apply what they learned in the presented recipes to their own projects. The feedback received on the use of recipes as a format was all overwhelmingly positive. Speaking on the recipes, one participant noted: “They were very fun and easy to follow...” (Escareño).

A possible limitation of using food and recipes is that not all artists will be interested or inspired by my aesthetic approach. For example, food imagery may not be resonant with practitioners whose work is more abstract or conceptual. Likewise, this limitation may have not been evident during my workshops as these kinds of practitioners may have simply self-selected out of participating.

6.3 Final Thoughts

I played many different roles in the development of this thesis. My exploration into new technologies began as an artistic endeavor but as time went on I took on the role of designer, maker and educator.

While these roles were all crucial to the development of this work, they were sometimes at odds. As designer and educator, my goal was to build an educational tool for creative practitioners to learn digital fabrication. As artist and maker, my goal was to apply my skills to make something beautiful.

An example of how these conflicting goals played out can be seen in the development of the *#MKRCookie* project. I took painstaking efforts to design and execute a beautiful Fruit Crème replica only to find this was far too challenging for someone new to digital manufacturing. Experiences like this one, however, did not discourage me. Rather, they helped crystalized my real challenge: to embrace this multiplicity and create something that reflected each of my roles, in balance.

The *Joy of Laser Cutting* is my answer to this challenge; it is at once an educational tool and an outlet for me to express my own creativity as an artist, designer, and maker. It has been rewarding to hear positive feedback from users who recognize and appreciate these distinct facets of my thesis.

Moving forward, I plan to continue adding new recipes, photos and videos to the website so that it continues to evolve as an educational tool. I would also like to explore the possibility of a print version of the material that can be used as a reference in classrooms or makerspaces.

I am not yet tired of making fake food. If anything, I am excited at the prospect of evolving this work and continuing to explore the joy of laser cutting.

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APPENDIX A - Research Ethics Board Approval Letter



June 12, 2017

Kate Hartman
Faculty of Liberal Arts & Sciences & School of Interdisciplinary Studies
OCAD University

File No: 101024
Approval Date: June 12, 2017
Expiry Date: June 11, 2018

Dear Kate Hartman, Ms. Alda Escareno,

The Research Ethics Board has reviewed your application titled 'Joy of Laser Cutting'. Your application has been approved. You may begin the proposed research. This REB approval, dated June 12, 2017, is valid for one year less a day: June 11, 2018. Your REB number is: 2017-22.

Throughout the duration of this REB approval, all requests for modifications, renewals and serious adverse event reports are submitted via the Research Portal.

Any changes to the research that deviate from the approved application must be reported to the REB using the amendment form available on the Research Portal. REB approval must be issued before the changes can be implemented.

To continue your proposed research beyond June 11, 2018, you must submit a Renewal Form before June 04, 2018. REB approval must be issued before research is continued.

If your research ends on or before June 11, 2018, please submit a Final Report Form to close out REB approval monitoring efforts.

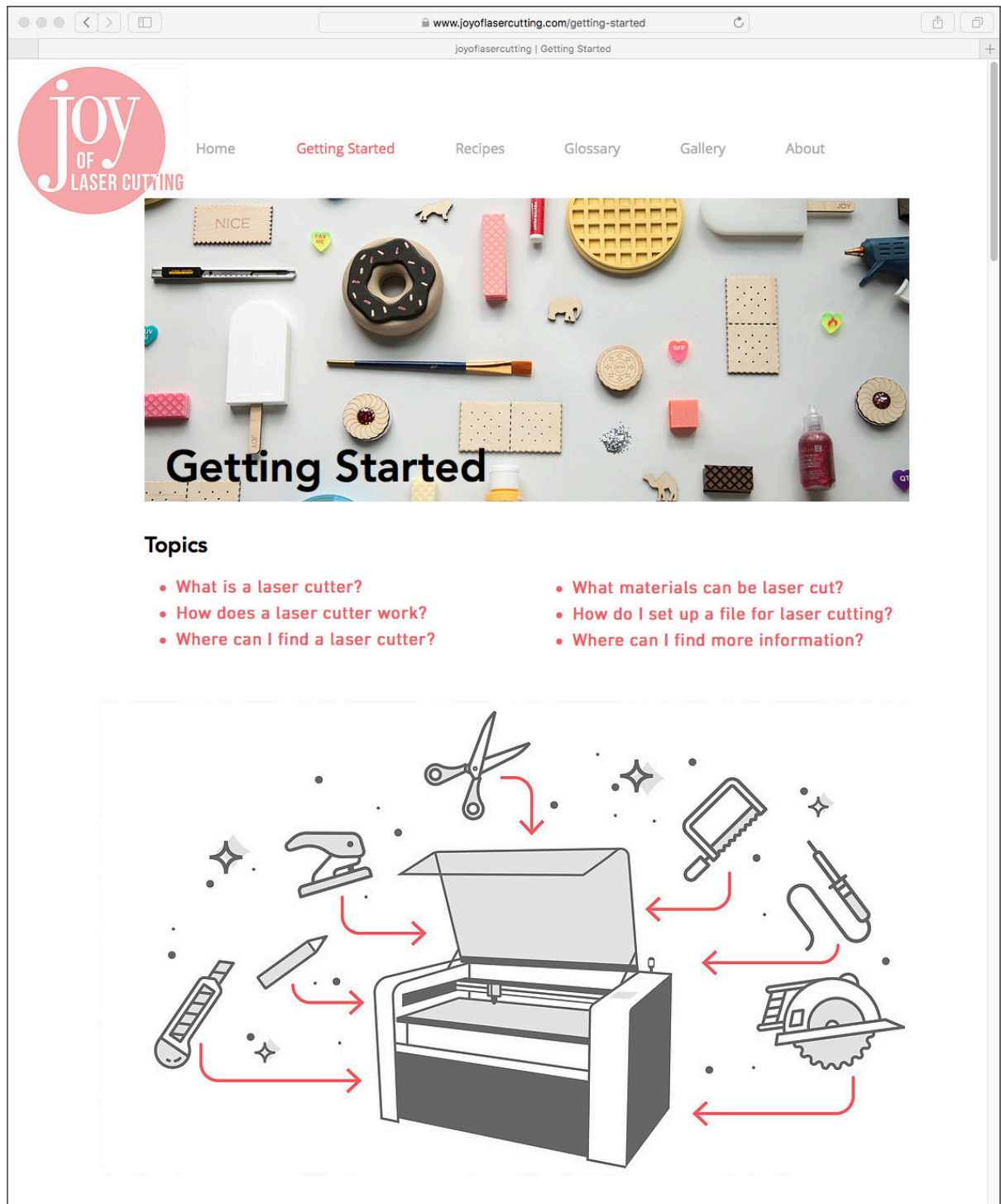
If you have any questions about the REB review & approval process, please contact the Christine Crisol Pineda, Manager, REB secretariat at

If you encounter any issues when working in the Research Portal, please contact our system administrator via

Sincerely,

Tony Kerr
Chair, Research Ethics Board

APPENDIX B - Getting Started Page from the Joy of Laser Cutting



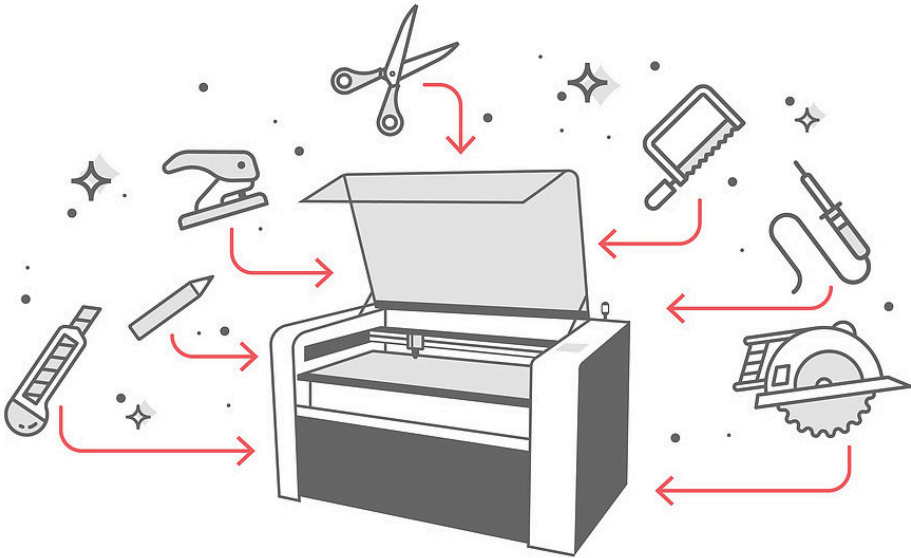
joy OF LASER CUTTING

Home Getting Started Recipes Glossary Gallery About

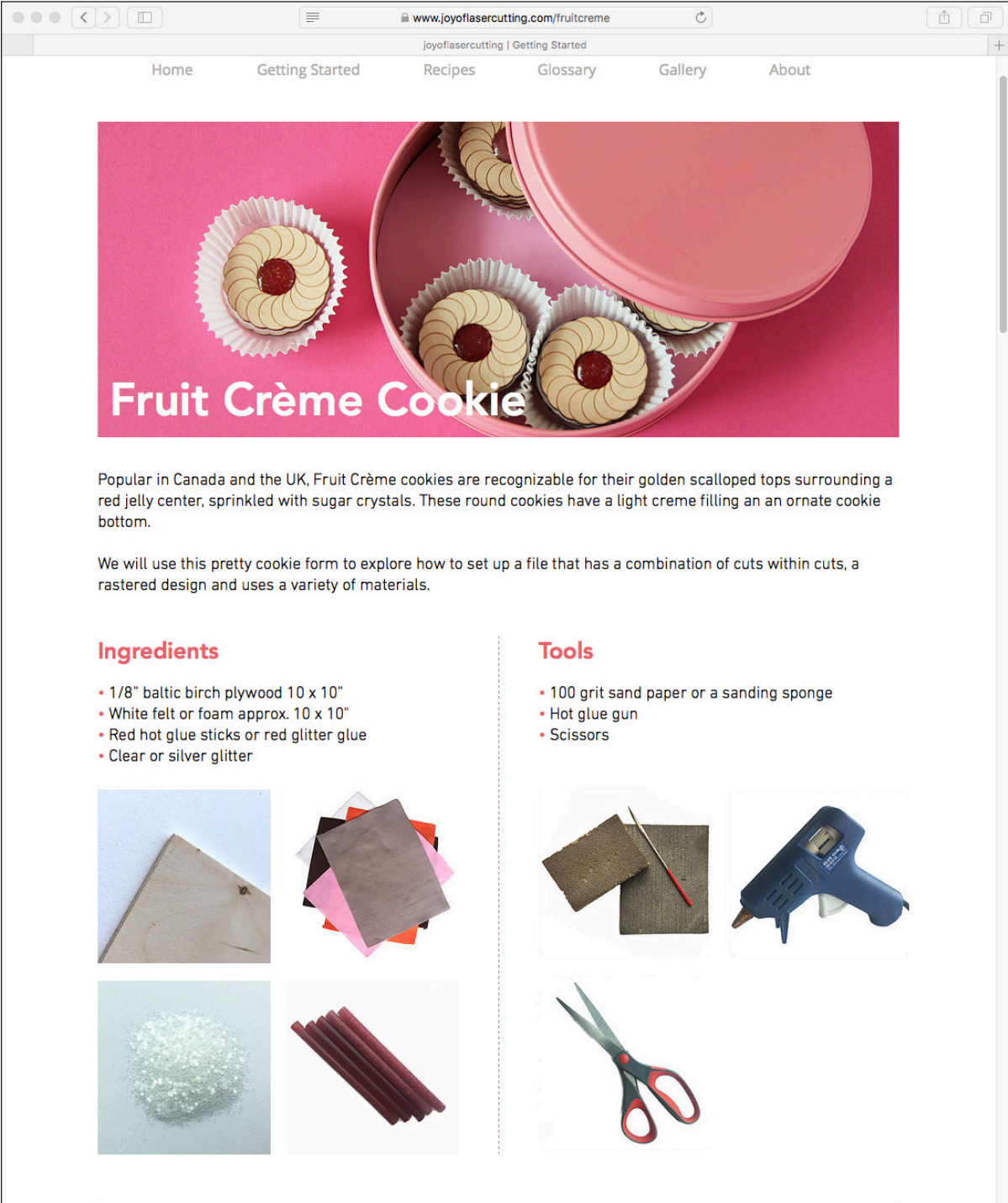
Getting Started

Topics

- What is a laser cutter?
- How does a laser cutter work?
- Where can I find a laser cutter?
- What materials can be laser cut?
- How do I set up a file for laser cutting?
- Where can I find more information?



APPENDIX C - Recipe Example from the Joy of Laser Cutting



The screenshot shows a web browser window with the URL www.joyoflasercutting.com/fruitcreme. The website has a navigation bar with links: Home, Getting Started, Recipes, Glossary, Gallery, and About. The main content area features a large image of 'Fruit Crème Cookies' in a pink tin. Below the image, the title 'Fruit Crème Cookie' is displayed in large white text. The text describes the cookies as popular in Canada and the UK, with golden scalloped tops and a red jelly center. It then states the purpose of the recipe: to explore laser cutting techniques. The page is divided into two columns: 'Ingredients' and 'Tools'. The 'Ingredients' column lists materials like plywood, felt, glue sticks, and glitter, accompanied by images of these items. The 'Tools' column lists sandpaper, a glue gun, and scissors, also with corresponding images.

Fruit Crème Cookie

Popular in Canada and the UK, Fruit Crème cookies are recognizable for their golden scalloped tops surrounding a red jelly center, sprinkled with sugar crystals. These round cookies have a light creme filling and an ornate cookie bottom.

We will use this pretty cookie form to explore how to set up a file that has a combination of cuts within cuts, a rastered design and uses a variety of materials.


Ingredients

- 1/8" baltic birch plywood 10 x 10"
- White felt or foam approx. 10 x 10"
- Red hot glue sticks or red glitter glue
- Clear or silver glitter

Tools

- 100 grit sand paper or a sanding sponge
- Hot glue gun
- Scissors

APPENDIX D - About Page from the Joy of Laser Cutting




- Home
- Getting Started
- Recipes
- Glossary
- Gallery
- About

About

The Joy of Laser Cutting is a website designed to introduce laser cutting to artists. The goal of this site is to encourage creative engagement with laser cutters by educating and inspiring artists about the possibilities that this technology offers. The site contains 9 step-by-step "recipes" for making different fake foods using a variety of laser cutting techniques. Artists can follow these recipes to learn the fundamentals of laser cutting, but are also encouraged to improvise, tweak, and make substitutions and they see fit.

This project grew out of my own experience looking to explore the potential for laser cutting in my own art practice. I had trouble finding resources and information that spoke to my interests & motivations as an artist; I wanted to be inspired, but all I found were tutorials on how to make keychains. With the Joy of Laser Cutting, I looked to fill this gap, by creating a resource for and by artists that not only teaches, but also inspires creative engagement with this exciting new medium.



The Joy of Laser Cutting is currently a work in progress. It is a part of Alda Escareño's Master's Thesis. She is a 2017 candidate for a MDes at OCAD University.

If you have any questions or feedback about this project, you can reach Alda via the form below. You can also follow her adventures here: [@multiplealdas](#).

Send

The **Joy of Laser Cutting** is a project by Alda Escareño.
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Creative Commons Attribution-NonCommercial 4.0 International License.