Instructor’s Script Manual for Maker Literacy Education in the US

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ILLINOIS MARKETPLACE & MAKER LITERACY PROGRAM

Subsistence Marketplaces Initiative, MakerLab, & College Outreach and Engagement COLLEGE OF BUSINESS UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN
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The true measure of this book is not so much in its writing but in whether those who read it in turn are inspired to work toward bettering the world for people living in poverty, one person or family at a time if need be.
Introduction

This script manual is a companion piece for our Maker Literacy slide deck. The Maker Literacy modules are designed to follow the lessons covered in the Marketplace Literacy USA modules. For more information about marketplace literacy and the research that went into this program, please refer to the Introduction in the Marketplace Literacy USA Educational Manual.

In this manual, we offer a suggested script for instructors to follow as they teach maker literacy. Instructors may choose – and are encouraged – to adapt this script to suit the needs of their classroom and students.

In cases where our text follows certain patterns of repetition, we have taken shortcuts in this manual for the sake of brevity. Text that appears in parentheses are instructions that are not meant to be read aloud, but followed by the instructor. It is assumed that instructors using this manual will not need suggested text for conducting these activities in the class. The same is true for repeating assignment questions to students.

Please note that access to Internet-based video is integral to the format of these modules, which are designed to show examples of each maker process through how-to videos on YouTube. In situations where Internet is not available during class, instructors may choose to substitute similar videos in other formats or provide face-to-face demonstration.

In the final module, which walks students through the process of 3-D printing, students will need access to an Internet-ready computer and a 3-D printer. This module also references a paper handout which students can use to follow instructions in real time during the class exercise. This handout is included at the end of the manual in Appendix A: Instructions for Printing.
Welcome to the Maker Literacy session. I am your facilitator for the three modules in this session. Before we begin the first module, I would like to set some goals for us to achieve together by the time we finish the three modules. First, I would like you to understand how you can use resources around you to make those things for fulfilling your own needs. Second, I would like to help you understand how you meet your daily needs by using things and services that are made in factories and that you buy from the market. And third, I would like you to know and learn how you would make things just like they are made in a factory to fulfill your needs, and also to use them for starting your own business.

Now, in the class, we will have an open discussion. Feel free to express your thoughts and your opinions, utilize opinions from your fellow classmates, build on top of those opinions, and express your thoughts so that there is a collective learning. You will see some videos in this session – so feel free and let me know if you need to understand a little more about any aspect of the video.
Module 1: Do It Yourself

Welcome to the first module of the maker literacy program. In this module, we will see how you can make things yourself and fulfill your needs on a regular basis.

In this module, we will see how you “do it yourself,” so to speak. When I say “do it yourself,” I mean how you can use certain resources around you to make things that can add value to your life. I would like to encourage an open discussion about these items, just like in the previous module. We will learn as a group how we can make things on our own, and how we can fulfill needs on a day-to-day basis.

What Can You Make?

- How do you make it?
- What rules or steps do you follow?
- What do you need physically or psychologically in order to make it?
- What physical or psychological needs are satisfied after you finish making it?

Now, before we start the module, I want to hear some experiences from your daily lives. Think about a typical day in your schedule and a certain activity that you do on that day. For example, think about making a cup of coffee or even watering your plants. Think about those activities, and tell me what you actually do while going about that activity. Focus on making certain things during those activities. What resources do you need to do that activity? What rules or steps do you follow in those activities? And again, what do you need physically or psychologically to make it? What are the needs that are satisfied after you are finished making it? So just take a minute and think about a regular day in a week and something you make as part of some activity on that day. I want to hear opinions from each one of you.

[Open floor for discussion]
Now keep those things in mind and let’s go into further detail. Talk to me a little about what ingredients and materials you would need to make them. Think about the steps involved. Think about every small aspect of that process. How much did those things cost you? Did they even cost you anything? Keep in mind that cost is not always about money. It could be anything else, like time, energy, or materials you already own, so tell me about those things as well. How much time did it take you? How did you put the materials together? What was the step-by-step process? What other factors made it possible? Did anyone else influence your making process? Did someone help you? Did you need to go somewhere to find specific supplies? Think about all the details of the entire process, and let’s hear from each one of you.

[Open floor for discussion]

I hope you are starting to understand the step-by-step process of making anything – be it on your own or in a factory, things that you need to make it, and needs you would fulfill after making it. I really appreciate your thought process into this subject.

Let’s talk about certain things you would like to make by yourself when you have some free time. Have you thought about making things on your own, besides what you do on a regular basis? Maybe you’ve looked at something and wished you could make that by yourself. Think about one such thing, and then let’s hear from all of you: what would you need in order to make those things? What steps are required for the process? Let’s take turns sharing something we would want to make and how we would make it. Think about the time required, materials, and costs involved. We have not talked about risks so far – there are always risks involved in making things. So let’s think about those as well. Let’s start with one of you and then hear from others as well.

[Open floor for discussion]
Let’s move on to discuss the “DIY” concept. What does it mean? It means you can make things yourself to fulfill your everyday needs: “Do It Yourself.” Certain things are made in factories. Now let’s see some videos of how things can be made by you! You eat food on a regular basis – let’s see how to go about cooking it. We will see how you can make a bag, how you can make a bird feeder, and even how to make a candle. So let’s start with food and go from there.

### Cooking

**Do It Yourself: Cooking**

Video 1:

What happens after you buy groceries? Do you cook your own meals?

What do you make? How do you make it?

Let’s learn how to make potato latkes!

So, cooking! How many of you like to cook? Raise your hands. And how many of you would like to cook if you don’t already know how? What happens after you buy groceries? Do you usually cook your own meals? Well, even if you don’t, what do you think happens with all the ingredients? What do you make? How does it get made? Let’s see this video about how you can make potato latkes.

[Play Video]
Now, I don’t know about you, but I am feeling hungry after that video! So what did we learn here? Let’s talk about what we saw in the video about cooking potato latkes. Tell me your observations. What details did you observe in that video? You all mentioned things you make in a regular day for your own needs. Tell me a few differences between those things and how you make potato latkes (or how you cook). Regarding potato latkes, let’s focus on physical and psychological requirements. Talk to me about what you would need to make this kind of dish. And, let’s discuss the needs that are satisfied by cooking. What do we gain out of this? Let’s open the floor and hear from each one of you.

I hope you had a good discussion. You need certain ingredients, you follow a step-by-step process, and you gain something out of the process that adds value to your life.

In terms of cooking, I’ll summarize it for everyone — you need certain ingredients to start with, like onions, potatoes, oil, and seasoning. You need a stove to cook on, a frying pan, utensils, and other things in order to go about the process. What are the psychological things that are required? You need to have an interest in cooking, or else a desire to eat that particular dish. If you don’t like to cook, you wouldn’t end up making a dish that is tasty because you would not really be interested in making it in the first place. Then, you need to follow a step-by-step process in the recipe. You cut onions and potatoes, you mash and mix them, fry them, and eventually add the salmon and capers on top. You follow a process that has steps that can be done only in a sequential manner. And at the end of the entire process, you gain something out of it. You have a dish in front of you that you can eat.

It fulfills certain needs — physical and psychological. Physically, it provides sustenance. You have to eat food to survive, so it fulfills that need. Psychologically, it provides a feeling of satisfaction!
Making Candles

Do It Yourself: Jar Candles

Video 2:

What do you do when the power goes out? Do you light a candle?

Have you ever made candles? Let's learn how!

That last video was about cooking. Now, let's look at the next product that you can make by yourself at home in your leisure time – jar candles. What do you do when the power goes out? Do you light a candle? Maybe you bought that candle from a store. Have you ever thought about making candles yourself? Let's see how you can do it yourself and the next time power goes out, you can burn your own candles!

Do It Yourself: Jar Candles

[Play Video]

That was a fairly easy way to make candles, right? I never knew about it before watching this video myself. Now, I know I can make candles myself and use them when the power is out. In fact, you can use them even when the power is on! You can use them to decorate your home. A very interesting video!

So, what did we learn here? What did you see that's different from all the processes we have seen so far? Talk to me a little about how this Do-It-Yourself process compares to cooking. What ingredients are needed – both physically and psychologically? What do we gain out of making a candle by ourselves? Let's hear from all of you.
I’ll summarize the candle-making process that we saw in the video. You need physical materials like wax, a jar, wicking thread, a pipe to keep the wick upright while the wax is liquid, and a way to melt the wax. You need to have the passion for making a candle – you need to know that if you make a candle successfully you would be using it for decorative purposes or when the lights go off. So, you need to have that interest in making a candle yourself. You also need to follow a step-by-step process – you cannot put the wick in molten wax later on. You need to stick it to the bottom of the jar right at the beginning and then pour the wax, not the other way around. So, a step-by-step process leads to a successful product that you can make by yourself. We already talked about the needs you can satisfy by making a candle. You can decorate your home or you can use it to light your home when the power is off. So essentially, there is a very simple process for making a candle but it goes a long way toward understanding how you can make things to satisfy your own needs.

**Tin Can Bird Feeder**

The next video is about a tin can bird feeder. How many of you like birds? Do you like attracting them in your yard? You always need a bird feeder to make that happen. Again, this is a very simple process, so let’s see how you can do that and make a bird feeder on your own.
Very simple, right?

This kind of DIY project is called *upcycling*. Upcycling means taking something that you would otherwise throw into the trash and turning it into something new and useful in some other aspect of your life. So we saw here that a tin can, which we would have thrown away, was turned into a bird feeder. This is what we mean by upcycling.

So I want to hear from all of you what you learned from the video. How do you see upcycling being beneficial, not only in this video, but otherwise? How is this type of making different from other Do-It-Yourself things we have talked about today? Would you try something else when you think about upcycling? What do you think you would do with things you would otherwise throw in the trash or recycle, and instead turn them into something new that you can use? Think about how you could use them to make life simpler on a day-to-day basis. Talk about these things.

We are really moving forward now. If you weren’t open to the idea of making things before, I hope you are more open to the process of making things for your own use now.

Here is a quick a summary about making this bird feeder: you need things that we would otherwise throw away (a tin can in this case); you upcycle it to make a bird feeder instead. You need wicking thread and you need something to drill through your tin can. You need to be careful about the process as well, following the instructions step by step. Eventually, you gain value by making it. You make a bird feeder to help attract birds.
Why would you do that? What’s the psychological need that this feeder fulfills? If you enjoy watching birds around your home, you can fulfill that psychological need by making a bird feeder on your own.

Keeping in mind the physical and psychological requirements of making a bird feeder, the step-by-step process involved, using a tin can and upcycling it, and bringing a value out of that process by fulfilling both physical and psychological needs – you can understand how the Do-It-Yourself process works in the case of this bird feeder.

Tote Bag

Do It Yourself: Sewing a Tote Bag

Video 4:

Have you ever seen? If so, what have you made? Did you use needle and thread or a sewing machine?

Let’s see how to make a bag!

Now, let’s move on to the last video: this is about making a bag. You need a bag to carry things, right? That’s a very basic need for when you go out every single day. You need to carry certain items with you, and you need a bag to carry those items. You eventually end up buying those bags from the market. But have you ever sewn anything yourself? If so, what did you make? How did you go about it – did you use a needle and thread or did you use a sewing machine for that? This video will show you how to make a tote bag at home, for your own purposes, in a very easy manner. Let’s see how we can do this.

Do It Yourself: Tote Bag

[Play Video]
What do you think about sewing after watching this video? Maybe you have done a little sewing at home, like sewing on a button or mending a torn shirt. But fewer people think of sewing a bag themselves. Now that you’ve seen this video, do you think you might try it for yourself? We could easily do this in 30-45 minutes. How is making a bag different from other Do-It-Yourself things we saw today – how is different from cooking, making a bird feeder or candle, or the other things you talked about in the beginning of this module? What needs are fulfilled, what ingredients or things you need to make a bag, and if you haven’t sewn before, would you try it after watching this video? Tell me a little more about that, because there are some finer details involved in this sewing process. Do you think, after looking at this video, that you feel ready to do that? Let’s hear your thoughts, collaborate each other’s ideas, and learn together.

[Open floor for discussion]

We are coming to an end of this module, but before we reach that point, let’s focus on what we have learned overall from this entire module. What’s the value we get from making things ourselves? What are your opinions of the process?

If you think about cooking, there were some physical and psychological requirements that were needed to successfully make a dish that we can eat and feel satisfied. What were those things? We need money to buy groceries and equipment like a stove, a frying pan, cooking utensils, etc. A lot of things go into making cooking a successful process! You need time as well, so that is another important component of this process. And then you gain something out of it – you satisfy your hunger on a physical level, and you can appreciate home-cooked food on a psychological level. So the value gained from this entire process really helps you appreciate the Do-It-Yourself method of making things.
Similarly, what goes into making a bird feeder? You need a tin can, a rope, a bamboo stick or pencil, and time to make it. You need knowledge and planning at a psychological level. And again, what do you gain from it? If you like watching birds, you would like feeding them and watch them come to your backyard to eat bird seed that you have put out for them to eat. The appreciation of nature and a passion for watching birds satisfies psychological needs. So on the whole, it is really interesting to see that a Do-It-Yourself process – be it cooking, making a birdfeeder – can be so easy if we think about the entire process, in terms of things that are needed to make that process successful and the values that we gain from that process itself.

**Conclusion**

Making products by hand is about a step-by-step process. We need to put in physical and psychological ingredients. We get physical and psychological outcomes in exchange. Making products ourselves is one way to satisfy our needs as consumers.

> Don’t buy what you can make. Make what you need.

This brings us to the end of Module 3. So to conclude, I would like to say that making products by hand is about a step-by-step process. We see how this is a little similar to making things in a factory, because even in a factory you saw you have to follow a sequential step-by-step process to make a product. Also, we need to invest physical and psychological aspects into the process to get benefits that are physical and psychological in exchange! So you need to put in something to gain something out if it – be it in a factory or in a Do-It-Yourself process that we saw in today’s module.

Making products ourselves is just one way to satisfy our needs as consumers. We also saw that another way to satisfy our needs is to buy things that are made in factories. I’d like to suggest that instead of buying things that you can make, make what you need! You can make a lot of the things that you use on a day-to-day basis yourself at home, rather than going out and buying them.

In the next module, we will learn how things we use on a regular basis are made in factories. I hope you will join us for this exciting lesson! Thank you for today.
Module 2: Made in a Factory

How do you think televisions are made?

Who makes them? Where?

In this module, we see how factories use certain physical and psychological components and follow a step-by-step process in order to make a product that fulfills certain physical and psychological needs for consumers.

Let’s start this module by having a small discussion about something that you use on a day-to-day basis – televisions. How do you think televisions are made? Who makes them and where do you think they are made? Let’s hear from you and compare the different opinions we get from the entire class here.

[Open floor for discussion, and go to the next slide when discussion finishes]

Making Products in a Factory

What steps do you think a factory takes to make a television?

What physical or psychological needs cause factories to make them?

What physical or psychological needs do the products satisfy for you?

With that thought process, I need the class to answer a few more questions. What steps do you think a factory follows in order to make a television? What materials are required? And what physical and psychological needs does a television satisfy? Let’s hear from the class.

[Open floor for discussion, and go to the next slide when discussion finishes]
I hope you had a good discussion.

Now, let’s see some other everyday products that are made in factories.

Ice cream – Who doesn’t love ice cream?
Toilet paper – We use toilet paper every day.
Suits – A lot of people wear suits.
Soccer balls – They’re also known as footballs outside the US.
Potato chips – Is there anyone who’s never heard of potato chips?

Now we’ll go one by one and understand how these things are made in a factory. So let’s start with ice cream.

**Ice Cream**

Are you one of those rare people who do not like eating ice cream? After watching the video on the next slide, you might want to eat ice cream every single day. But on a serious note, have you ever wondered how they make the kind of ice cream you buy at the store? Let’s watch the video to see how it’s made.

[Play video]
After that video, I don’t know about you all, but I’m craving ice cream right now! But let’s talk about what we saw in the video. Talk to me a little about what you learned about how ice cream is made. Let’s think in terms of how that process is different from the way a television is made in a factory. Let’s discuss the things that are required – physical as well as psychological – in making ice cream, and what physical and psychological needs ice cream satisfies. Why do you feel like you need ice cream? Let’s hear from somebody who has not answered already and then everybody else can join in the discussion.

Different Ways of Making Things in a Factory

- What did you learn about how ice cream is made?
- How is this type of “making” different from others?
- What does a factory need physically or psychologically in order to make ice cream?
- What physical or psychological needs does the product satisfy?

[Open floor for discussion]

So, in a nutshell, I would like to say that making ice cream is a process that has physical as well as psychological components. To make it in a factory, you need milk, ingredients for specific flavors like chocolate, and machines. These are the physical things required for making ice cream. There are also some psychological components required – you need to know the step-by-step process and the recipe. If you don’t follow the steps in a sequential manner, the ice cream may not turn out well. So we see how both physical and psychological things are required for making ice cream, even in a factory.

Now, what physical and psychological needs does the ice cream satisfy? On the physical side, it quenches your thirst and it can feel soothing on a hot day. And on the psychological side, there is enjoyment in eating something that tastes sweet and delicious. So you see how the output of the factory also meets the physical and psychological needs of people like you and me.

Soccer Ball
Now let’s see some other products that are used on a day-to-day basis. How many of you are sports fans? Did you see the Soccer World Cup in Brazil? Did you ever wonder how those soccer balls were made? Well, let’s see the special process for making these soccer balls that were used in the Soccer World Cup in Brazil.

[Play video]

Interesting video, right? It’s fascinating to see how a soccer ball is made with such complex processes. Let’s talk about what we saw in the video. Talk to me a little about what you learned about a soccer ball being made in a factory. How is the process different from, let’s say, a television or even ice cream?

What were the big differences that you saw? What kind of things are needed – physically and psychologically – to make a soccer ball? And again, talk to me a little about what needs are satisfied by making a soccer ball in a factory – both physical and psychological. Let’s hear from somebody new now, and let’s add to the discussion with different thoughts.
I hope you can now differentiate between the factory-making processes of ice cream, television sets, and even soccer balls. Now, let me answer what goes into making a soccer ball. In terms of physical requirements, you need the material that goes inside the soccer ball and material that goes on its surface. We saw six panels being put on top. A lot of machinery is used and different machines have different purposes. You have a lot of people in the factory using those machines – so these are all the physical things you would require.

In terms of psychological requirements, a designer created the unique combination of shapes and colors that makes the Brazilian World Cup balls different from other soccer ball designs. The people behind the World Cup wanted these soccer balls to stand out and look unique, and this uniqueness is a psychological aspect of this particular design. So both physical and psychological things went into making the perfect soccer ball that was used in the World Cup.

Now, what needs are satisfied by making a soccer ball? Let’s break it down again into physical and psychological issues. Physically, it allows us to play soccer and get some exercise. Professional players who make a living by playing soccer can use this income to pay bills and satisfy even more basic physical needs for things like food and clothing. Psychologically, soccer balls help us entertain ourselves. So, both physical and psychological needs are met with a soccer ball made in a factory.

Toilet Paper

Let’s move to another product that we use on a day-to-day basis – toilet paper. We use toilet paper every day. How do you think it is made? Do you think each tube is rolled separately? Let’s watch this video to find out.
Would you have ever expected to hear a song about toilet paper? That was a great video, I think. What do you have to say? Let’s talk about what we learned from the video. How is making toilet paper in a factory different from the ways in which television sets, ice cream, or soccer balls are made? Let’s also discuss what physical and psychological elements go into making toilet paper, and what kind of needs that toilet paper satisfies for us. Let’s hear from someone new.

[Open floor for discussion]

Now, in a quick summary, what are the physical and psychological things that go into making the toilet paper? Physically, we need paper. Paper comes from trees, so we need a lot of trees. We also need a lot of chemicals and machines to make paper out of those trees. Psychologically, there is a feeling of hygiene and cleanliness. And again, there is a step-by-step process that we saw in the video that goes into making toilet paper rolls.

Now, what needs are satisfied by toilet paper? It clearly satisfies our physical needs every single day. Psychologically, there is a feeling of hygiene and cleanliness.

Suits
Let’s move on to the next product that we will talk about – suits. Do you ever wear a suit? How many of you wear suits? Do you like wearing suits? Raise your hand if you do. What do you think is the step-by-step process for making suits? Let’s talk about that, but first, let’s watch a video.

[Play video]

Different Ways of Making Things in a Factory

What did you learn about how suits are made?

How is this type of “making” different from others?

What does a factory need physically or psychologically in order to make a suit?

What physical or psychological needs does the product satisfy?

It’s really interesting to see how a simple thing, like suits, is made using such complex methods in a factory. So what did you learn from this video? You know the exercise by now – let’s discuss what you learned from the video, how it is different from all the videos you’ve seen so far, what are the things required in order to make suits, and what kind of needs are satisfied by wearing as well as making a suit in the factory? Let’s hear from all of you, one at a time.

[Open floor for discussion]
Thank you all for sharing your ideas! Now, I'll quickly summarize what we have seen in this video. So, what do we need in order to make a suit in a factory? We need some physical things like fabric, thread, machinery, and people to run that machinery. And on the psychological side, we need creativity. We heard in the video that a designer designs a suit based on his creative ideas. So, creativity is a psychological ingredient in this process. Clearly, physical and psychological effort need to be put together and a step-by-step process has to be followed for making a suit. If you don’t follow the step-by-step process, you may not end up making a good suit.

Now, what needs are satisfied by making a suit in the factory? On the physical end, you need good clothes for formal occasions. When you have an interview, attend a wedding, or go to a formal party, you might wear a suit. On the psychological side, we heard it right at the end of the video – people feel good when wearing a suit. A level of satisfaction is achieved by wearing a suit.

**Potato Chips**

Let’s move to the last video of this module – potato chips. I am very sure that all of you have eaten potato chips. How do you think they are made? What steps are involved? Let’s have a look.

[Play video]

Wow, a million pounds of potato chips in a single day! Now that’s a lot of potato chips. So we know the exercise – let’s talk about what happens in the factory there. What did we see in the video? I want to hear your thoughts about what is required in the factory to make chips. Tell me something besides potatoes and machines – I want to hear something new. And again, on the psychological side, what do you think is a factor here? How is making potato chips different from all the videos we have seen so far? Are there some
similarities as well? Let's talk about similarities this time. What are the needs satisfied by potato chips at the end of the day? Let’s hear from somebody new.

Different Ways of Making Things in a Factory

[Open floor for discussion]

Value from Factory-Made Toilet Paper

Now, it’s really good we started looking into some similarities as well. We talked about how different things are made in different ways in a factory. But now that we are talking about similarities as well, we see how toilet paper here in this slide, and potato chips in the next slide, have a lot of similarities. You need machines, you need some common ingredients to start with, time, and labor on the psychological side for making the product – be it toilet paper or potato chips. And, what is made addresses physical and psychological needs. With toilet paper, you achieve hygiene and comfort like we discussed a few slides ago.
And with potato chips, we fulfill our hunger and our satisfaction. So, there are a lot of differences and similarities, but at the end of the day we understand that there is a lot that goes into making something in a factory, which then provides physical and psychological benefits for consumers. Making really adds value to our lives. It fulfills a need that we have in our day-to-day lives. This is what we have understood from all the videos we have seen and all the discussions we have had so far.

**Conclusion**

This brings us to the end of the factory module of the maker literacy session. I hope you were able to learn something from this module. In conclusion, I’d like to say that making products in a factory is a step-by-step process. You saw how everything that is made in a factory requires one step to be done at a time, after which you can do another step. And this stepped process requires some physical and psychological elements. You need fabric in order to make suits; you need potatoes in order to make potato chips; you need a recipe in order to make ice cream.

And, we as consumers of these products gain something out of the process. The output adds value that has a physical as well as psychological effect on our lives. You need toilet paper to take care of everyday business, and you need a suit when you have a job interview or other formal occasion. Junk foods like ice cream and potato chips can satisfy psychological food cravings in ways that bread and water can’t.

In order for this stuff to be made in a factory, the factory’s ability to produce a consistent product means that it needs to have a high degree of accuracy in its step-by-step process. In other words, if the same physical and psychological elements are put in a step-by-step process in a factory, you would get the same physical and psychological output every single time with the same accuracy, fulfilling the same needs on a day-to-day basis when we use them.

I hope you enjoyed this module and I hope you learned a lot. In the final module, we will talk about how you make things on your own that look like items made in a factory – through the magic of 3-D printing. I hope you will join us for this exciting lesson! Thank you for today.
Module 3: 3-D Printing

Maker Literacy: 3-D Printing

Welcome to the third module of the maker literacy session. First, we saw how you can make things to satisfy your daily needs on your own through the Do-It-Yourself. Next, we saw how things that we use on a daily basis can be made in a factory, what is required to make those things, what are the steps that go in a sequential manner, and what do you gain out of that factory-making process.

In this module, we will use both of those concepts to see how it’s possible for you to make something that looks like it was made in a factory. Let’s get on with the session. As always, I encourage discussion, and any questions that come along will be answered.

What if YOU could make something that looks like it was made in a factory?

What if you could make something that looked like it was made in a factory? For example, have a look at this mobile phone case. Most of you have phones with you. Have you ever thought of making a mobile phone case by yourself? If you have, it can be very difficult at first to understand how you would go about it. If it was a tote bag like the one we saw in the previous module, you would need some cloth and you would sew it together to make a bag out of it.

But with the example of a phone case, how would you go about making a piece of plastic that could serve the purpose of your mobile phone’s case? What are your thoughts on this?

[Open floor for discussion]

Even if you could take small pieces of plastic from other things that you do not use anymore, cut them down, stick them together, resize them to your phone’s size, paste them together, and tape them together – you would not have a piece that would look as if it had been made in a factory. You cannot do it in that manner.
What is 3-D Printing?

Have you heard of something called 3-D printing? Does anybody have any idea of how it works or what it is? 3-D printing is basically a sum of both things we have discussed in the previous modules. One, you can make things yourself. And two, the things will look as if they were made in a factory. And what do you get out of it? You get things that you make yourself with the same precision and consistency as if they were made in a factory. Let’s move forward and see 3-D printing in a little more detail.

Video: What is 3-D Printing and how does it work?

A few years ago, who would have thought that you could sit at home and print things in real life that you could use for so many purposes? What do you think you could make using a 3-D printer?

With what you have learned from that video and the discussions we have had so far in the last two modules, give me a few ideas for things that you would like to make using a 3-D printer. What things would you make if you had a 3-D printer right here, right now? Talk to me a little more about the details: what would you like to learn if you could make that thing using a 3-D printer? Share your opinions. I want to hear a collaborative opinion from all of you. Build on top of each other’s responses. I want to hear what you would make using a 3-D printer.
What can you Make with 3-D Printing?

[Open floor for discussion]

We saw in the video that people are making houses and buildings in China using a 3-D printer. You can make food items and even body parts. I’m sure you will be able to think more creatively once you learn more about the concept of 3-D printing, and how you can use it to make many things.

Instruments

So, here are just a few examples of what can be made using a 3-D printer. We can make musical instruments – people are already using drums, guitars, flutes, violins, and cellos made by 3-D printers. How many of you like to play musical instruments? How would you like to be able to make a new instrument every single day?

Industrial Parts

Here, you can see the limitless possibilities for making pieces of equipment that are used in industries. You can make small or big parts; NASA is using 3-D printers to make things they need in their space missions.
Automotive and mechanical manufacturers are using 3-D printers to make small parts that are used in cars and other machines. You just need to have a design (or make a design) for the part that you want to fit in a machine, put it in a computer, do some basic editing, and print it out using a 3-D printer. That’s how much you can achieve and that’s how powerful 3-D printing is in today’s world.

Medical/Bio

This technology is advancing medical science as well. People are making body parts that can be used on real human beings like you and me. These body parts are made by 3-D printers. Yes, the material of the body part is very much like what you and I have – the same tissue and biological material.

Consumer Products

In terms of consumer products, people are making shoes, jewelry, and electronics as well. You see all that you can do using a 3-D printer. It’s really interesting to see how far we can go in terms of our imagination and use 3-D printing to make things that we use on a day-to-day basis.

Again, to bring everything into context, we learned how things are made in factories and how things can be made at home using the resources around us. But if we had a 3-D printer at home, we could make things we use on a day-to-day basis just as if they had been made in a factory. That’s the power of 3-D printing.

How 3-D Printing is Changing What We Can Make
So, now you have seen how 3-D printing can be used to make a number of things. You can practically think of anything and everything, and make it using a 3-D printer today. But how is 3-D printing changing the way we make those things? How is it changing the process in which we make those things?

1. First, if you have an idea today, you can make it into a reality at a very fast pace. If you had access to a computer and a 3-D printer, you could make a cup that you would like to use for drinking coffee at a fraction of the time it would take for a potter – or even a factory – to make a ceramic mug. You would just need to design the cup on the computer and print it using a 3-D printer.

2. Second, it allows consumers to have the power. You and I are consumers, and we buy a lot of the things we need. But now, you could make many of those things if you had a 3-D printer. This allows you to save a lot of money, time and energy.

3. Third, 3-D printing has a very low environmental impact in terms of the energy it uses and its carbon footprint. In other words, it is good for the environment as well.

4. Fourth, 3-D printing allows you to make items that have the same quality, precision, and consistency as those items that are made in factories. You can make a factory-quality item on your own.

5. And fifth, it increases our ability to make what we need. There are many times that we have to buy very small quantities of things, or replace something very specific that’s hard to find. How many times have you had to buy a whole package of bolts when you only need one? Or, what if you had to replace a complex part for your food processor, or a knob on your stove? With a 3-D printer, you can make those things on your own. You can make them and use them to fix machines that would work just fine once they had a small part replaced. Being able to make small items for specific needs really adds a lot of value to your day-to-day life.
Those are the ways that 3-D printing has *changed* the process of making things, but what are the benefits? There are four benefits to keep in mind:

1. First, 3-D printing allows you to reduce waste. You don’t waste a lot of material, because as you saw in the video, 3-D printing is also called additive manufacturing. By additive manufacturing, we mean that it adds material one layer over another without adding anything that will have to be cut off or removed later. In that way, it really saves you a lot of money indirectly.

2. Second, a 3-D printer does not take much time to set up. It is just like a 2-D printer in that way. You need to place it somewhere, connect it your computer, and add the material that it prints — in this case, plastic instead of paper.

3. Third, you can design complex products. We just saw how we can make very small parts of machines – parts that could be used in an electric mixer or nuts and bolts.

4. Fourth, it allows customization of products. You can make anything you want. I have emphasized this a number of times now that you can customize the products in your own way. Think of the coffee cup that I mentioned. You could design the cup to look the way you want. You can have a color that you want or have a design or picture on it that you print right on the cup.

**Discussion**

1. Would you like to make something using a 3-D printer?

2. Name two things that you would like to make.

3. Based on what you’ve learned so far, what do you think is needed to make both of them?
By now, I hope you have an idea of what 3-D printing really means, as well as the kinds of things that can be made, the changes it brings to the process of making, and the benefits that you can have in your day-to-day life by using a 3-D printer.

**Getting Ready to Print**

Would you like to try to make something using a 3-D printer? If yes, name two things that you would like to make. Try to think of simple, small items for now: it’s good to start small before working up to more complex things to make. Based on what you have learned so far, what do you think you would need to make those two items? Think in terms of material, time, your own skills, and other resources that are very important when it comes to using a 3-D printer. Tell me a few ideas that you have – two things, from each person, and the things that are needed to make them using a 3-D printer.

[Open floor for discussion]

Now that you have a couple of ideas for what you would like to make using a 3-D printer, it would really help you if you knew how to use one. I’ll help you understand the basics of how this can be done.

**Three Ways to 3-D Print**

There are three methods for using a 3-D printer:

1. **Method 1** is to download an existing design from the internet. There are numerous designs available for objects and items that we use on a day-to-day basis. Earlier, we mentioned a cup that you can use to drink coffee – there are designs available for that. A keychain, perhaps – designs are available for that, as well as small decorations for your home. A lot of common items that we see around us have designs available on the Internet. You can download them on your computer and print them using a 3-D printer.

2. **Method 2** is to use a 3-D-scanning method. Let’s imagine you want to make something that looks exactly like something else. For example, if you have a coffee cup and you would like to make another cup that looks exactly that, you can take a 3-D scan of the existing cup. This method creates a picture of what the cup looks like inside and outside, which would allow you to print a new cup based on that scan. The scanning method helps you see what an existing object looks like, replicate it, and print it using a 3-D printer.
3. Method 3 allows you to design an object yourself. There are a few types of software available that you can use to design any object that you would like, of any shape, color, height, or dimensions. You can use that design to print using the 3-D printer.

To review, there are three ways to use a 3-D printer – download an existing design, scan an existing object, or design a new object yourself. Next, we’ll explore these methods in depth.

**Download and Print**

Now, I would like you start exploring the first method – download and print.

Go to your computers and log on to www.thingiverse.com. This website has many of the designs available on the Internet. It is one of the most common websites.

If you go there, you can see a lot of options. I would like you to search for the two things that you have thought about printing. You have an “Explore” tab at the top; go to the category you were thinking about and try to search for the two things you wanted to print using a 3-D printer.

If you are not able to find those exact things, see if you can find something similar. If you have found those, now you can print them using a 3-D printer in a matter of a few hours.

The instructions for those printing methods are available on the sheet next to you. Please follow them and ask me if you have any questions.
I would like to understand how you feel as we go through these modules and sessions. Do you feel capable of making objects using a 3-D printer? What kind of feelings do you have at this point in time? Give me a brief explanation of what you are thinking right now.

[Open floor for discussion]

[Allow activity to proceed and assist where needed personally]

**Scan and Print**

Now, I’ll give you a brief description of how the second method of 3-D printing works – the scan and print method. There are a few types of scanners that will allow you to scan and print. You have the option of using a hand-held scanner or you can use a smartphone with a scanning app. There are also some high-end scanners that are used for scanning large objects, though they are mostly used for industrial purposes.

For this class, let’s focus on hand-held scanners as an example. We can use a hand-held scanner to make a small bust of someone – a tiny, 3-D portrait. As the model is being scanned, a 3-D likeness begins to appear on the computer. You can use that design to print a small version of the model.

That’s a small example of how you can use scanning to print. We can discuss this method in greater detail after this class, and there are a few instructions for it on the handout.

**Design and Print**
As we mentioned before, the third method of 3-D printing is to create your own design. There are a number of types of software available online that you can download and use to design objects you would like to print. The most common one is Tinkercad, but there are others available like Sketchup and Autodesk. Most of these programs have many options available that allow you to decide the size, length, breadth, and height of the object you want to make. Your design doesn’t need to have a simple shape like a square or a circle; you can make your own shape. If you would like to write something, you have options to add text on the object as well, and even choose the color of the object. Everything that you would like to design in the object that you are going to print can be controlled using software. So, this is where everything starts when you are planning to make something new.

This kind of method requires a little more training. Again, the instructions are available on the handout, but I would love to discuss more about this method of 3-D printing in the next class. It will take several steps to reach the final output – that is, the object you would like to print. So, I would like you to be comfortable with the first two methods right now before we move on to the design and print method.

Video: Making Mr. Jaws at the MakerLab

[Play Video]

Conclusion

In this maker literacy class, we have discussed many ways of making things. We saw how we can make things on our own and use them for our own purposes. We have seen how things are made in factories for consumers like you and me. We buy them for our daily needs. And we have seen how we can use a 3-D printer to make factory-like items to fit our needs as well.
Discussion: If you were a customer...

Would you buy what you made?

How much would you pay?

What do you get from it?

What do you give in return?

What are some things you wish you knew as a customer?

Now, let’s think in terms of being a customer. Would you buy the item you made? How much would you pay for it? How do you decide how much it’s worth to you? What do you give and what do you get with something like this?

Remember how we’ve talked about value in exchange? It’s important to think about the things we give up in exchange for the things we get from our purchases. This isn’t just about money, but also about time, effort, and any other consideration that might apply.

Sometimes you have to weigh the benefits between multiple options, like comparing phone plans.
Let’s consider something else. Do you think you could sell the item that you make using a 3-D printer to someone else? How much do you think people would pay for the object that you have made right now? What are they giving and what are they getting?

What would you like to make on a 3-D printer? Why? How would you feel about starting a business by selling things that you make using a 3-D printer? How would you go about building a business around your product idea? What have you learned in our companion marketplace literacy program that will help you to do so? Do you think you could make enough money to keep a business going on a long-term basis? If not, why do you think it couldn’t happen?

What are some issues to consider if you wanted to develop a business to sell what you make? Tell me about other items that you think you could make and sell besides the 3-D printed item that you just made. Let’s hear what you have to say. I want to understand what you think about using a 3-D printer and selling, and if you think it’s something you would want to get into as a business.

[Open floor for discussion]

This brings us to the end of the final module of the maker literacy session. I really wish we had more time to discuss the possibilities of making things using a 3-D printer. At the same time, I hope you have learned a lot through these modules.

3-D printing allows us to make real, usable objects without a factory setting. We need a 3-D printer in order to make this happen. With the help of modern technology, we can make factory-like, accurate, and consistent products ourselves. We can make things that people can use, and sell those things as a business. 3-D printing makes it possible for us to make things ourselves and sell what we make.
To conclude, I would like to encourage you to get creative and think about objects that are needed on a day-to-day basis, and that could be made with a 3-D printer. You can make them, start your own business, and sell them. Thank you for being involved in the discussions all along. I hope you have learned a lot that you can use in your day-to-day life.
Appendix: Instructions for Printing (Handouts)

Getting Started with 3-D Printing @ the Illinois MakerLab

1. Get an overview of the printing process on a Replicator2 printer at http://www.youtube.com/watch?v=AKTSdW7-H3Q

2. Use any type of modeling software you are comfortable with. For beginners, we highly recommend Tinkercad, an online 3-D modeling software (no downloads required; Firefox/Chrome work fine) because it is easy to use and we have an educational account which gives you all the features of a paid account. You can make an account using the link above. If you are using a pre-designed model from a website such as www.thingiverse.com, you can tweak it on Tinkercad, or use as is.

3. After you finish designing your model (or if you are reusing an existing model), make sure it is a stereolithography file (.stl). Other file types may not open on Makerware, a software used to process a 3-D model into a form suitable for printing. You can download Makerware on your computer to process the file before you get to the lab, or you can use the computers in the lab to process your model. On Tinkercad, select Design, and click on Download for 3-D Printing to get to this step.

4. Once your .stl file is saved, it can be opened on Makerware. The file itself will not open on its own. If a dialog box comes up asking to put your model on the build platform, hit yes, otherwise your model will be suspended in the air and will not print.

5. Once your model shows up on Makerware, make sure it looks how you want it to. The model can also be scaled/moved if need be. Remember, the smaller the size, the faster it prints. Printing occurs much more smoothly if the largest surface area of the model is situated on the build platform.

6. If everything looks to be in place, save your file. The file saves as a .thing file type. After your model is saved, click Make It. The default print settings work for most models; however, for larger models, an infill of 10% to 25% is recommended. Before changing any other settings, consult a Guru.

7. Before hitting Export, plug in the USB with the SD card attached. When you export the file, make sure it is saving to the correct location. The file type should be set as .x3g, but if it is not, select it.

8. During the exporting process, Makerware slices your 3-D model into several 2-D layers. It will go through a slice, verify, and digital printing process before it is ready to use. Once that finishes, the file should be on the SD card and ready to print.

9. Insert your SD card into one of the printers, and print from the SD card.

Quick Tips and Tricks for Printing

1. Before printing, it is always a good idea to level the build platform. To do this, go to Utilities and toggle down to Level Build Plate. Follow the directions on screen to finish the leveling process. The correct distance between the build platform and the nozzle should be when the piece of paper barely slides
between the two.

a. For quick reference, turning the knob clockwise raises the platform and counterclockwise lowers the platform.

b. If the model comes off the build platform during printing, this is the first course of action after cancelling the build.

c. If the first extruded filament looks round as opposed to flat, this would be the best course of action as well.

2. To cancel a build, hit the left arrow on the machine and follow the directions.

3. If the base of the model is fairly thin, it may be necessary to include a raft.

4. If the plastic stops extruding during printing, try loading the filament to make sure there is not a problem with extruding. To do this, go to Utilities, toggle down to Change Filament, and select Load. If filament extrudes, exit the menu and try re-printing.

5. Do you hear a clicking sound while printing? Stop the print, go to Utilities, toggle down to Change Filament, and select Unload. Follow the directions on screen. Once the filament is out, cut the filament off at an angle (ask the Guru for tools) and reload the filament by hitting Load instead of Unload.


**Useful Resources – Videos in the tutorial Above**

3. How to Use Makerware: [http://www.youtube.com/watch?v=YLpWWXOmw4](http://www.youtube.com/watch?v=YLpWWXOmw4)
After logging in, Tinkercad will bring you to an empty workplane grid, similar to the picture shown below.

Use either the mouse or the navigation tools in the upper left corner to navigate around the work plane. Scrolling up zooms in, scrolling down zooms out, and to three-dimensionally rotate the work plane, right-click with the mouse and drag to the desired view.

When modeling your designs using the predetermined shape, you must be able to control the shape and size of the objects you import. In the picture above the geometric shape of a pyramid has been placed on the work plane with default dimensions. To move objects placed on the work plane, left-click with the mouse and drag. To change the shape of the object, you can click and drag any of the available white or black squares shown on each vertex and edge of the shape. If you would like to move the entire object up or down, left-click the black arrows with the mouse and drag in the direction you would like. To rotate an object, left-click the black curved arrows at the vertices and drag to the desired position.
Shown to the right is the Tinkercad Toolbar. This is where all design components come from. Each section provides a selection of shapes to build with. Below is a description of some of the available functions.

**Shape Generator:**
- **Image Generator** - Allows you to import a picture to be used in your design (will not show up in 3-D print).
- **Text** - Allows you to import a typed line of text to be used in your design.
- **Extrusion** - Allows you to create abstract shapes to be used in your design.
- **Ring** - Allows you to create a ring of any shape and size to be used in your design.

**Helpers:**
- Allows you to switch from only working on a grid (Work plane) to working on a grid with measurements provided (Ruler).

**Geometric:**
- Provides a variety of different predefined shapes to be used in your design.

**Holes:**
- Instead of adding material in a certain spot, this function removes material or creates a “hole”.

**Letters/Number:**
- Letters provides a model of each letter A-Z and Number provides a model of each number 0-9.

**Symbols:**
- Provides models of the symbols @, &, !, ?, as well as dice, a diamond, star, heart, and the Tinkercad logo.

**Extras:**
- Provides additional unique models including an egg/egg hole, bunny ear, and a chicken foot.

The picture below shows the Undo/Redo, Adjust, and Group/ Ungroup commands located at the top right of the homepage.

**Undo/Redo:**
- Reverses the last completed operation.

**Adjust:**
Aligns two selected shapes based on specified geometry.

**Group/Ungroup:**

Allows you to take two separate shapes and group them into a single object.

Finally, the picture below shows the main menu for Tinkercad located in the upper left corner. The Design menu is used to export your Tinkercad file to a .stl file once you have finished modeling. The Edit menu allows you to copy, paste, duplicate, or delete selected items. If you are stuck or would like access to additional Tinkercad tutorials, the Help menu contains tutorial videos as well as a link to “Learn more about Tinkercad”.

![Tinkercad Menu](image)
Photographic and Video References

Images for the Maker Literacy Script Manual and Slide Deck are the work of Warren Widjaja and the Illinois MakerLab unless otherwise noted below. Other photos and videos are credited in the order in which they appear.

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Hand-held Scanner: the Artec 3-D Spider 3-D Scanner, https://www.flickr.com/photos/33907867@N02/13936704048/ by Creative Tools via http://compfight.com https://creativecommons.org/licenses/by/2.0/

Screenshot images of Tinkercad, SketchUp, Autodesk 123-D Design.