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Module Title: Beginner's Guide to 3D Printing

Target Audience: This module's target audience is a new owner of a Creality Ender 3 (various models) 3D printer. This module will be available online via QR code or link on written instructions within the box of the Ender 3 model.

Learning Objectives:

At the end of the training, learners will be able to:

1. Identify the different components and the function of these parts on an Ender 3 printer.
2. Recognize the steps needed to correctly level the build plate and fine tune the printer.
3. Describe the different types of filaments used in 3D printing.
4. Manipulate settings in the slicer to obtain the desired printed object.

Seat Time: 30 minutes – 1 hour

Outline:

Introduction

- Welcome
- Navigation
- Objectives

Topic: Identify the parts and function of an Ender 3 printer (LO 1)

- Identify parts and show the function of each part using images
- Knowledge Check

Topic: Level the build plate (LO 2)

- Learn the 5 steps to successfully level the build plate
- Video (how to level the build plate)
- Knowledge check

Topic: How to fine tune the printer (LO 2)

- Under Extrusion
- Draft - Possible solutions to solve draft issues
- Nozzle

Topic: Types of Filaments (LO 3)

- Each type of filament will include the chemical name for the abbreviation and different characteristics.
- Knowledge check

Topic: Print Settings (LO 4)

- Each of these print settings identifies general guidelines, features, and some ways to troubleshoot.
- Knowledge check

Assessment

- 5 Questions – all 5 questions assess the 4 learning objectives.

Summary

Conclusion

Directions:

- To ease navigation in this document, you can click on the links in the table of contents to take you to specific topics.
- As you review this storyboard, please place extra attention on the accuracy and completeness of the content included during the review cycle.
- Any questions that are specific for reviewers are highlighted in green. Any questions that reviewers have should be highlighted in pink. All questions will be addressed before content creation begins.
- The text in the Narration/Voice Over column will be narrated audio.
 - As you review this text, please be aware that there may be additional words that makes the audio flow. Try reading it aloud to see if it sounds correct and make notes of changes, as necessary.
 - Any formatting to this text is simply to help the voiceover talent – the Voice over text will not be seen by the learners.
 - Capitalization in this text is not important as it is not seen by the learners
- Text in the Slide Text column requires correct capitalization, punctuation, and grammar as this will be seen by the learner.

Module Resources/References: 3D Printing Job Aid

Theme:



Fonts:

- Title – Britannic Bold
- Normal text - Candara

Slide template:

Rounded rectangle with only right side of rounding present on the slide in the dark red with the title of the slide in white on it. This will fly in from the left on each slide. The dark grey or image of red/grey integrated circuit as the background. The player will be the default Modern Storyline player.



All assets required to produce this course will be provided to the eLearning developer.

Slide size should be 16:9 aspect ratio (1280 x 720).

Introduction

Slide 1.1/Menu Title: Welcome			Objective: N/A
Visual / Display:	Slide Text:	Narration / Voiceover:	Animation / Interaction:
<p>An irregular pentagon in the dark red color sits on the left side of the screen covering about 1/3 of the slide. Centered text on the pentagon indicates the name of the course. The background is a looping video of a 3D printer in the process of printing an object.</p> <p>Title bar is not present.</p> <p>Start and Navigation buttons are horizontally distributed on the bottom ¼ of the right side of the slide. They are dark red rounded rectangles with the “title” text.</p>	<p>[Slide Title] Welcome</p> <p>[slide subtitle] A Beginner’s Guide to 3D printing</p> <p>[Button1] Start</p> <p>[Button 2] Navigation</p>	<p>Welcome! You are beginning your journey into three D printing. New printers, parts, and add-ons are being developed constantly. While this hobby can be engaging, it can also be incredibly rewarding, and it will rarely be boring or monotonous. This course is designed to help you understand the basics of an Ender 3 3D printer, the types of filaments available, and what some of the most important settings are within your slicer. To begin the course, click Start. If you need a tutorial on how to navigate this course, please click on Navigation.</p>	<p>As the slide begins, the pentagon flies in from the left, after it is in place, the text flies in from the left also. As the VO plays, the Start and Navigation fades in with the audio.</p> <p>Navigation button takes learner to the navigation slide (1.2) while the Start button takes the learner to the Learning Objective slide (1.3)</p> <p>Next and Prev buttons are not present.</p>

Slide 1.2/Menu Title: Navigation			Objective: N/A
Visual / Display:	Slide Text:	Narration / Voiceover:	Animation / Interaction:

On the background there should be screen shot of the welcome slide within the player. The title bar is not present. Fill the remainder of the slide background with a similar color as the screenshot will not fit the entire slide.	<p>[Slide Title] Navigation</p> <p>[Slide Text] Click Next when you are ready to begin the course.</p>	There are a few different options to help you navigate this course. The two most important buttons are the next and the previous buttons. The next button will take you to the next slide, while the previous button will take you to the slide before. You may see the submit button on quiz questions or knowledge check slides. Click submit to send your answer and move to the next slide. If you need to adjust the volume, please use the volume button. The seek bar will allow you to move forward or backward on the audio, video, or animations on the slide. Use this if you need to reread or listen to the audio again. The play and pause button will allow you to pause any animation, video, or audio until you are ready to listen again. Simply click pause or play to resume. You may use the menu on the left to navigate to different slides in the course, for example, if you need to review information before taking a quiz. When you are ready, click the next button to begin the course.	<p>As the VO plays, speech bubbles with the name of the icons will pop up.</p> <ul style="list-style-type: none"> • Navigation (moves from next to prev labels with VO) • Volume • Seek bar • Play/pause • Menu <p>The above objects fade out when the VO moves on to the next object.</p> <p>Text “click next...” fades in with VO.</p> <p>Next button goes to slide 1.3. Prev button goes to slide 1.1.</p>
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Slide 1.3/ Menu Title: Learning Objectives			Objective: N/A
Visual / Display:	Slide Text:	Narration / Voiceover:	Animation / Interaction:

<p>Background image consists of a stylized integrated circuit board in the color scheme as noted above with the title bar.</p> <p>Irregular pentagon takes up about ½ of the right side of the slide. Transparency is set at 15%.</p> <p>Bullet points for each LO are a grey chevron shape pointing towards the right.</p> <p>The title and beginning part of the text is in the “title” font, while the remainder is in the “normal” font.</p> <p>All text on this slide is white.</p>	<p>[Slide Title] Learning Objectives</p> <p>[subtitle] At the end of this course, you will be able to:</p> <p>[bullet points]</p> <ul style="list-style-type: none"> Identify the different components and determine the function of these parts on an Ender 3 printer. Order the steps needed to correctly level the build plate. Describe the different types of filaments used in 3D printing. Manipulate settings in the slicer to obtain the desired printed object. <p>Click NEXT to continue</p>	<p>In this course, you will be exploring 3D Printing. By the end, you will be able to identify the different parts of an Ender 3 printer. Order the steps needed to correctly level the build plate. Describe the different types of filaments used in 3D printing and Manipulate settings in your slicer to obtain the desired printed object.</p>	<p>Irregular pentagon flies in from the right.</p> <p>Learning Objectives title and “at the end...” flies in from the bottom with VO.</p> <p>Each objective, grouped with the chevron flies in from the left with the VO.</p> <p>Click Next fades in at the end of the timeline.</p> <p>Prev button goes to slide 1.1.</p> <p>Next Button goes to slide 1.4.</p> <p>Next button is disabled until the audio is complete.</p>
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	Slide 1.4/ Menu Title: Scenario			Objective:
Layer name	Visual / Display:	Slide Text:	Narration / Voiceover:	Animation / Interaction:

Base Layer 1.4	<p>Title bar is present.</p> <p>Slide has dark grey background with 2 characters on the slide – the first character will be in the lower left (Laura) while the second character is in the upper right (Cole) with a jagged line dividing the slide into 2 parts on a diagonal from top left to bottom right.</p> <p>Speech bubbles are present from each character when the VO is talking for that character.</p>	<p>[Slide Title] Scenario</p> <p>[Text w/in Speech bubbles] [Laura] Thank you for calling Creality Customer Service. My name is Laura. May I ask whom I am speaking with?</p> <p>[Cole] Hello, Laura. My name is Cole and I’m calling for assistance in getting my Ender 3 working properly. I’ve tried a few different things but I can’t seem to have much success. Between prints not sticking to the bed, a ton of stringing, uneven layers during the first few layers... I’m frustrated!</p> <p>[Laura] I’d be happy to help you work through some of the issues you are having. Many first time 3D printing hobbyists find themselves in the exact same place, so don’t feel like you are alone. We’ve all started at the beginning, just like you are know.</p>	<p>[Telephone ringing] [Laura] Thank you for calling Creality Customer Service. My name is Laura. May I ask whom I am speaking with?</p> <p>[Cole] Hello, Laura. My name is Cole and I’m calling for assistance in getting my Ender 3 working properly. I’ve tried a few different things but I can’t seem to have much success. Between prints not sticking to the bed, a ton of stringing, uneven layers during the first few layers... I’m frustrated!</p> <p>[Laura] I’d be happy to help you work through some of the issues you are having. Many first time 3D printing hobbyists find themselves in the exact same place, so don’t feel like you are alone. We’ve all started at the beginning, just like you are now.</p> <p>Have you gotten to know the different parts of your printer yet and how they work? This will be important because as we talk about how to adjust, level, and fine tune your printer, you’ll need to know what parts I’m talking about.</p> <p>[Cole] I’ve got a few things down, but most of them I don’t know what they do. I’d really appreciate it if you can help with this part.</p> <p>[Laura] No problem! Why don’t we get started? Click next to Meet the Ender 3</p>	<p>Text fades in with VO in each respective speech bubble.</p> <p>Next button is disabled until the scenario is finished playing.</p> <p>Prev button goes to slide 1.3 Next button goes to slide 1.5</p>
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		<p>Have you gotten to know the different parts of your printer yet and how they work? This will be important because as we talk about how to adjust, level, and fine tune your printer, you'll need to know what parts I'm talking about.</p> <p>[Cole] I've got a few things down, but most of them I don't know what they do. I'd really appreciate it if you can help with this part.</p> <p>[Laura] No problem! Why don't we get started?</p> <p>[Slide text] Click Next to Meet the Ender 3.</p>		
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Topic: Identify the parts and function of an Ender 3 printer (LO 1)

	Slide 1.5/ Menu Title: Meet the Ender 3			Objective: LO1
Layer name	Visual / Display:	Slide Text:	Narration / Voiceover:	Animation / Interaction:

Base layer – 1.5	<p>The same background as slide 1.3 is used here with a title bar. Image of the Ender 3 is centered above the slide bar which is light grey with the slider in light red color. There are 12 different states to this image, each state corresponds to the image as the 3D printer rotates. Image 1 will be set for normal, then image 2 will be state 2, etc.</p> <p>Laura character is on the left side of the printer image.</p> <p>Cole’s character is on the right side of the printer.</p> <p>Directions for navigation shows just to the right of the title rounded rectangle in white.</p> <p>Each marker will have a normal and visited state.</p>	<p>[Slide Title] Meet the Ender 3</p> <p>[Slide Text] All buttons must be visited before moving forward.</p> <p>[Marker text] Motherboard</p> <ul style="list-style-type: none"> • Integrated circuit • All electrical component connect here. 	<p>[Laura] Ok, Cole. Now you are going to learn the names and functions of different parts of an Ender 3. Use the slide bar to rotate the printer 360 degrees. As you rotate, click on the information buttons to learn more.</p> <p>[Marker audio] Within this small black box, you will find the motherboard. This is an integrated circuit where all of the different electrical components connect to. It is the brain of the printer.</p> <p>[Cole] How can I find out what motherboard I have? I’ve seen posts on social media that talks about different versions.</p> <p>[Laura] In order to find out which specific board you have, you have to remove the cover from the box and look at what is printed on the integrated circuit inside.</p> <p>[Cole] That seems easy enough!</p>	<p>Restrict the learner from moving the slider bar while audio is playing on all layers.</p> <p>Slider interaction has 11 positions 1 – 11.</p> <p>At position 1, a marker is placed over the motherboard. This appears with the VO indicating to click on the marker. The marker is light red in color and changes to black when visited.</p> <p>Next button is disabled until all markers have been visited. Use a numerical variable for this. When the marker is clicked, increase the variable value by 1.</p> <p>As the learner moves the slider bar, the state of the image will change to the corresponding state. The layer for each corresponding state will trigger that layer to show.</p> <p>Next button goes to slide 1.4. Prev button goes to slide 1.6.</p>
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<p>Gantry – 1.5a</p>	<p>State of Ender 3 changes to 2.</p> <p>Marker is added to the gantry as positioned on the corresponding image.</p>	<p>[Marker text]</p> <p>Gantry</p> <ul style="list-style-type: none"> • Horizontal bar • Hot end attached • Hot end moves left and right • X-axis • Tighten with concentric nuts 	<p>[Laura]</p> <p>The gantry is the horizontal bar that the extruder moves along. This is also called the x axis. It is important to make sure that this bar is level and tightened by adjusting the concentric nuts. If it isn't, you will likely have printing issues.</p> <p>[Cole]</p> <p>I've noticed that the right side of my gantry is pretty loose. So I should tighten those concentric nuts?</p> <p>[Laura]</p> <p>That is the first step. Sometimes you must loosen all three, get it level, then retighten them. We will learn about another option to keep the gantry level a bit later in the tour.</p>	<p>When the slider is at position 2, show this layer.</p> <p>When user clicks on marker, the audio plays and numerical variable increases by 1.</p> <p>Prevent learner from clicking on the seek bar while audio is playing.</p>
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Hot end assembly – 1.5b	<p>State of Ender 3 changes to 3.</p> <p>Marker is added to the hot end assembly as positioned on the corresponding image.</p>	<p>[Marker text]</p> <p>Hot End Assembly</p> <ul style="list-style-type: none"> • Fans for cooling • Hot end melts filament • Thermistor communicates temperature information with motherboard 	<p>[Laura]</p> <p>The hot end assembly includes fans for cooling and the hot end. The hot end melts the filament and allows it to be pushed through the nozzle. You will also find the thermistor here. If you ever have issues with thermal runaway, you may have to replace your thermistor.</p> <p>[Cole]</p> <p>So the hot end assembly includes the fans, the hot end, the nozzle, and the thermistor? I'll have to make some notes about that so I remember it later!</p> <p>[Laura]</p> <p>Yes. The nozzle is here too. You may want to have some spare nozzles on hand so you can easily swap them out if you get a clog.</p> <p>[Cole]</p> <p>That's great advice. Thanks!</p>	<p>When the slider is at position 3, show this layer.</p> <p>When user clicks on marker, the audio plays and numerical variable increases by 1.</p> <p>Prevent learner from clicking on the seek bar while audio is playing.</p>
Filament Spool – 1.5c	<p>State of Ender 3 changes to 4.</p> <p>Marker is added to the filament spool as positioned on the corresponding image.</p>	<p>[Marker text]</p> <p>Filament Spool Holder</p> <ul style="list-style-type: none"> • Can mount in different locations • Holds spool • Spool spins freely • Often replaced with aftermarket options 	<p>[Laura]</p> <p>The filament spool holder comes with the printer. Depending on your model, it may sit at the top of the printer, or it might sit at the bottom. This holds the spool of filament so that it can freely spin as the printer uses filament. Many 3D printing enthusiasts will use other after market.</p> <p>[Cole]</p> <p>I think I've seen some of those after market options on social media before I purchased my printer. I'll stick with the factory version for now.</p>	<p>When the slider is at position 4, show this layer.</p> <p>When user clicks on marker, the audio plays and numerical variable increases by 1.</p> <p>Prevent learner from clicking on the seek bar while audio is playing.</p>

Z-stop – 1.5d	<p>State of Ender 3 changes to 5.</p> <p>Marker is added to the z-stop as positioned on the corresponding image.</p>	<p>[Marker text] Z-stop and Stepper Motor</p> <ul style="list-style-type: none"> Prevents hot end from damaging the print bed Turns Z-axis screw to raise and lower gantry 	<p>[Laura] The z-stop is a small switch that will prevent the z-axis from lowering too far and damaging the print bed. The stepper motor which is also located here moves the z-axis screw to move the gantry up and down.</p> <p>[Cole] Damaging the print bed? Yikes. That sounds like it could be an expensive fix. I better make sure that's in the right position!</p>	<p>When the slider is at position 5, show this layer.</p> <p>When user clicks on marker, the audio plays and numerical variable increases by 1.</p> <p>Prevent learner from clicking on the seek bar while audio is playing.</p>
Build Plate – 1.5e	<p>State of Ender 3 changes to 6.</p> <p>Marker is added to the build plate as positioned on the corresponding image.</p>	<p>[Marker Text] Build Plate</p> <ul style="list-style-type: none"> Also known as “bed” Moves forward and backward Filament adhesion is key Clean and level build plate leads to success 	<p>[Laura] The build plate is where the magic happens. Also commonly referred to as the bed, it can also be the source of much frustration if your build plate isn't leveled properly. The build plate moves forwards and backwards during printing. The filament needs to stick to the bed in order for prints to be successful. There are different settings that will allow you to change how your print will adhere to the bed. You will learn this later in the course. If you hit a snag with your 3D printing, always start by making sure you have a clean, level build plate.</p> <p>[Cole] This is definitely one of the skills that I’m struggling with. No matter how often I try to level the bed, the middle is always so wavy.</p> <p>[Laura] We will talk about other ways to fine tune your printer in a little bit if you know your bed is level.</p>	<p>When the slider is at position 6, show this layer.</p> <p>When user clicks on marker, the audio plays and numerical variable increases by 1.</p> <p>Prevent learner from clicking on the seek bar while audio is playing.</p>

X stepper motor – 1.5f	<p>State of Ender 3 changes to 7.</p> <p>Marker is added to the x stepper motor as positioned on the corresponding image.</p> <p>Marker is added to the extruder as positioned on the corresponding image.</p>	<p>[Marker text]</p> <p>Extruder</p> <ul style="list-style-type: none"> • Can be all metal or metal with plastic components • Advances and retracts filament <p>Stepper Motor</p> <ul style="list-style-type: none"> • Moves the belts for the X-axis • X-axis moves left to right 	<p>[Laura] [X stepper motor VO]</p> <p>This stepper motor is for the x-axis. It is what moves the belts to which the hot end is attached. It moves the hot end left and right to allow it to reach all areas of the print bed.</p> <p>[Cole]</p> <p>Do I need to do anything to maintain this part?</p> <p>[Laura]</p> <p>Not really. Just make sure that the belt moves freely and isn't too dusty.</p> <p>[Extruder VO] [Laura]</p> <p>The extruder is also shown here. Depending on the model of your printer, you may have an all-metal extruder, or one that has some plastic parts to it. The extruder is responsible for advancing and retracting the filament during printing.</p> <p>[Cole]</p> <p>My extruder is all-metal. I've noticed that sometimes little particles of filament end up around the gears. I'll have to make sure to keep that area clean.</p>	<p>When the slider is at position 7, show this layer.</p> <p>When user clicks on marker, the audio plays and numerical variable increases by 1.</p> <p>Prevent learner from clicking on the seek bar while audio is playing.</p>
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Y-stop and Stepper motor – 1.5g	<p>State of Ender 3 changes to 8.</p> <p>Marker is added to the y-stop and stepper motor as positioned on the corresponding image.</p>	<p>[Marker text] Y-Stop and Stepper Motor</p> <ul style="list-style-type: none"> Prevents bed from moving too far Moves belts for forward and backward motion of the bed 	<p>[Laura] The y-stop and the stepper motor shown here is responsible for stopping the bed from moving too far forward or backward. The stepper motor is attached to the belts which move the print bed. Between the print bed moving forward and backward and the hot end moving left and right, all areas of the print bed can be reached by the hot end.</p> <p>[Cole] Are these two parts housed together like the hot end assembly or are they separate?</p> <p>[Laura] They are separate, but they are right next to each other. The stepper motor will be attached to the belt that moves the bed.</p>	<p>When the slider is at position 8, show this layer.</p> <p>When user clicks on marker, the audio plays and numerical variable increases by 1.</p> <p>Prevent learner from clicking on the seek bar while audio is playing.</p>
Power Supply – 1.5h	<p>State of Ender 3 changes to 9.</p> <p>Marker is added to the power supply as positioned on the corresponding image.</p>	<p>[Marker text] Power Supply</p> <ul style="list-style-type: none"> Electricity enters Cooling fans Runs on 220V or 110V Check the red switch for voltage 	<p>[Laura] The power supply is where the electricity enters the printer. The power supply has its own cooling fans and can run on 220 volt or 110 volt. Check the red switch on the back to ensure that your printer is running at the correct voltage.</p> <p>[Cole] I've got my printer plugged into a normal US outlet. That's 110v, correct?</p> <p>[Laura] Yes, 110 v is typical in American homes.</p>	<p>When the slider is at position 9, show this layer.</p> <p>When user clicks on marker, the audio plays and numerical variable increases by 1.</p> <p>Prevent learner from clicking on the seek bar while audio is playing.</p>

Dual z-axis – 1.5j	<p>State of Ender 3 changes to 10.</p> <p>Marker is added to the dual z-axis as positioned on the corresponding image.</p>	<p>[Marker text]</p> <p>Dual Z-axis</p> <ul style="list-style-type: none"> • Add-on • Controls both sides of the gantry equally • Keeps gantry level 	<p>[Laura]</p> <p>Some hobbyists will choose to add different components to their printers to enhance their experience. Since this printer has a long gantry, the owner opted to add a dual z-axis. This allows the gantry to move up and down on both sides equally. If you are finding that you cannot get the gantry level, this might be an option for you to add later. Earlier when we were discussing the gantry, this is what I talking about. The Ender 3 Max has a much longer gantry than the Ender 3 or Ender 3 Pro, so that's why this model has the dual z-axis.</p> <p>[Cole]</p> <p>Ok. That's helpful to know. I have the Max model, so this will be something to look into if I can't get the gantry level.</p>	<p>When the slider is at position 10, show this layer.</p> <p>When user clicks on marker, the audio plays and numerical variable increases by 1.</p> <p>Prevent learner from clicking on the seek bar while audio is playing.</p>
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Interface – 1.5j	<p>State of Ender 3 changes to 11.</p> <p>Marker is added to the Interface as positioned on the corresponding image.</p>	<p>[Marker text] Interface</p> <ul style="list-style-type: none"> • Controls printer • Communication display for motherboard • Allows you to fine tune your printer 	<p>[Laura] The interface is where you will control the printer. Some models will have a touch screen, while others have a rotating button. The interface is the display for what the motherboard is communicating. You will use the interface to preheat the extruder and bed, calibrate your e-steps, and fine tune other aspects of your printer.</p> <p>[Cole] Quick question.</p> <p>[Laura] Sure, what can I help with?</p> <p>[Cole] The way the menus show up on the interface may be different depending on what firmware the machine has installed, correct?</p> <p>[Laura] Yes. Some people opt to change their firmware. This is very important if they choose to add an auto-leveler to their printer.</p> <p>[Cole] Cool. Thanks. This makes it much easier to understand all the different parts.</p> <p>[Laura] I'm glad that's been helpful. If you feel like you know all the names and functions for each part, click next to test your knowledge!</p>	<p>When the slider is at position 11, show this layer.</p> <p>When user clicks on marker, the audio plays and numerical variable increases by 1.</p> <p>Prevent learner from clicking on the seek bar while audio is playing.</p>
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Notes: The image that is shown on the base layer (normal state) will be different than the image on each layer (state 1, 2, 3, etc.), therefore the markers will need to be placed as they would appear to be on that corresponding image. For example, the gantry on “normal” image will be in a different location than on the “2” image.

	Slide 1.6/ Menu Title: Knowledge Check			Objective: LO1
Layer name:	Visual / Display:	Slide Text:	Narration / Voiceover:	Animation / Interaction:

Base Layer – 1.6	<p>The background is dark grey with title bar.</p> <p>Image 1 (of printer) is on the bottom left of the slide while image 8 (of printer) is on the bottom right of the slide.</p> <p>On each of the images listed above, there are small grey stars (the same size as those in the red rectangles) with 2 additional states, correct (green) and glow (red).</p> <p>The stars (numbered 1-4) left image are located at the hot end assembly, motherboard, build plate, and interface.</p> <p>The stars (numbered 5-8) on the right image are located at the power supply, gantry, extruder, and y-stepper motor.</p> <p>There are 8 rectangles in medium red with a small light grey star on the right side. Each red box has text for the 8 different parts listed in the next column.</p>	<p>[Slide Title] Knowledge Check</p> <p>[Rectangle labels]</p> <ul style="list-style-type: none"> • Hot end assembly • Y-stepper motor • Motherboard • Extruder • Gantry • Interface • Build plate • Power Supply <p>[Slide Text] Move the stars from the images to the stars within the rectangle. When you are finished, click submit.</p>	<p>[Laura] There will be two parts to this knowledge check. On this slide you will be showing that you know the name of the different parts of the printer. Move the stars from the images to the star within the rectangle. When you are finished, click submit. You will have two chances to get them right.</p>	<p>This is a free form drag and drop interaction.</p> <p>Stars will have a correct (green) and incorrect (red) state that will appear after the learner submits.</p> <p>Next is hidden. Prev button goes to 1.5.</p> <p>Restrict learners from clicking while the audio is playing.</p>
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Correct 1.6a	<p>Create a new slide background by covering the default slide with the dark grey background. Add Laura on the left of the slide and Cole on the right.</p> <p>The continue button has a dark red background with the “title” font.</p>	<p>[Slide Text] Correct!</p> <p>You got them all correct. You certainly know all of the parts of the Ender 3 printer. When you’re ready to test your function knowledge, click continue.</p> <p>[Continue button] Continue</p>	<p>[Laura] Amazing! Keep going, rock star!</p>	<p>When user clicks “correct,” go to slide 1.7</p>
Try Again 1.6b	<p>Create a new slide background by covering the default slide with the dark grey background. Add Laura on the left of the slide and Cole on the right.</p> <p>The Try Again button has a dark red background with the “title” font.</p>	<p>[Slide Text] Incorrect.</p> <p>You didn’t quite get them all correct. The stars that are red are incorrect. Try rearranging them again. Click submit when you have moved all of the red stars.</p>	<p>[Laura] You didn’t quite get them all – Go back and move the pink stars and see if you can get them correct.</p>	<p>When user clicks “Try Again”, hide the layer.</p>
Incorrect 1.6c	<p>Create a new slide background by covering the default slide with the dark grey background. Add Laura on the left of the slide and Cole on the right.</p> <p>The continue button and Review button has a dark red background with the “title” font.</p>	<p>[Slide Text] Incorrect.</p> <p>The stars should be placed in this order:</p> <ol style="list-style-type: none"> 1- Hot End assembly 2- Motherboard 3- Build plate 4- Interface 5- Power supply 6- Gantry 7- Extruder 8- Y-stepper motor 	<p>[Laura] Unfortunately, you didn’t get them all. In order of stars numbered, here are the correct answers:</p> <ol style="list-style-type: none"> 1. Hot End assembly 2. Motherboard 3. Build plate 4. Interface 5. Power supply 6. Gantry 7. Extruder 8. Y-stepper motor 	<p>When user clicks “review,” go to slide 1.5.</p> <p>When user clicks continue, go to slide 1.7.</p>

	Slide 1.7/ Menu Title: Knowledge Check			Objective: LO2
Layer name:	Visual / Display:	Slide Text:	Narration / Voiceover:	Animation / Interaction:
Base Layer – 1.7	<p>The background is dark grey with title bar.</p> <p>There are 8 rectangles in medium red with a light grey rounded rectangle on the right side. Each red box has text for the 8 different parts listed in the next column.</p> <p>In addition to the red boxes above with those labels, there should also be white rounded rectangles located at the center of the slide between the two images with the text shown in the next column. These are the drag objects in the drag/drop interaction.</p>	<p>[Slide Title] Knowledge Check</p> <p>[Slide Text] Drag the functions of the parts to the correctly named part. Each part will only get one function.</p> <p>[Drag & Drop- answers in brackets]</p> <ul style="list-style-type: none"> • Motherboard communicator – [interface] • Integrated circuit for components – [motherboard] • Heats filament – [hot end assembly] • Advances/retracts filament – [extruder] • Moves build plate forward/backward – [Y stepper motor] • Provides electricity – [power supply] • Horizontal bar, holds hot end – [gantry] • Prints are produced here – [build plate] 	<p>[Laura] Your job on this slide is to identify the function of each of these printer parts. Drag the function to the gray rounded rectangle. When you think you have them complete, select the Submit button. You will have two chances to get them right. Good luck!</p>	<p>This is a free form drag and drop interaction.</p> <p>The middle 4 red boxes will fly in from each side of the screen – two from the left, two from the right. The remaining 4 boxes will do the same, after the first 4 have appeared.</p> <p>White rounded rectangles fade in with VO.</p> <p>Next is hidden. Prev button goes to slide 1.4 Submit button is present.</p>

Correct – 1.7a	<p>Create a new slide background by covering the default slide with the dark grey background. Add Laura on the left of the slide and Cole on the right.</p> <p>The continue button has a dark red background with the “title” font.</p>	<p>[Slide Text] That’s right! You certainly know all the parts and functions of an Ender 3!</p>	<p>[Laura] Wow! You got them all! Nicely done!</p>	<p>Continue button goes to slide 1.6.</p>
Try Again – 1.7b	<p>Create a new slide background by covering the default slide with the dark grey background. Add Laura on the left of the slide and Cole on the right.</p> <p>The Try Again button has a dark red background with the “title” font.</p>	<p>[Slide Text] That is incorrect. You didn’t quite get all of the functions correct. Try again by rearranging the red shapes.</p> <p>[Button 1] Try Again</p>	<p>[Laura] You didn’t quite get them correct. Try again, but this time look for the red ones which indicate they are incorrect.</p>	<p>Try again button hides the layer.</p>

Incorrect – 1.7c	<p>Create a new slide background by covering the default slide with the dark grey background. Add Laura on the left of the slide and Cole on the right.</p> <p>The continue button and Review button has a dark red background with the “title” font.</p>	<p>[Slide Text] You did not select the correct response. Try going back to the Meet the Ender 3 slide again to review.</p> <p>The correct answers are:</p> <ul style="list-style-type: none"> • Motherboard communicator - interface • Integrated circuit for components – motherboard • Heats filament - hot end assembly • Advances/retracts filament -extruder • Moves build plate forward/backward - Y stepper motor • Provides electricity -power supply • Horizontal bar, hods hot end - gantry • Prints are produced here - build plate <p>[Button 1] Review</p> <p>[Button 2] Continue</p>	<p>[Laura} Unfortunately, you didn’t get them all correct. Since this is key information, I would recommend going back and reviewing the functions before moving on. If you choose to move on, you can come back to that slide to review at a later time.</p> <p>The correct answers are:</p> <ul style="list-style-type: none"> • Motherboard communicator - interface • Integrated circuit for components – motherboard • Heats filament - hot end assembly • Advances/retracts filament -extruder • Moves build plate forward/backward - Y stepper motor • Provides electricity -power supply • Horizontal bar, hods hot end -gantry • Prints are produced here - build plate 	<p>Review button goes to slide 1.5.</p> <p>Continue button goes to slide 1.8.</p>
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Topic: Level the build plate (LO 2)

	Slide 1.8/(hidden from menu)			Objective: N/A
Layer name:	Visual / Display:	Slide Text:	Narration / Voiceover:	Animation / Interaction:
Base Layer 1.8	Use the same basic layout as the previous scenario slide.	[Slide title] Scenario	[Laura] Wow Cole! You did well on those knowledge checks. Are you ready to move on to the steps to level your bed?	Text fades in on speech bubbles with VO.
	<p>Laura's character is still on the left while Cole's is still on the right.</p> <p>Each character has speech bubbles that pop up when they are speaking.</p>	<p>[Laura] Wow Cole! You did well on those knowledge checks. Are you ready to move on to the steps to level your bed?</p> <p>[Cole] Absolutely! I've tried so many times to level my bed and I just get so frustrated. I thought I had it, but then when I went to print, I just got a horrible mess because the filament didn't stick to the build plate.</p> <p>[Laura] That's understandable. As I've mentioned before, there is a handy add-on called an auto-leveler that will help adjust for any nonconformities in your build plate. When you're ready to go to the next slide, click next.</p>	<p>[Cole] Absolutely! I've tried so many times to level my bed and I just get so frustrated. I thought I had it, but then when I went to print, I just got a horrible mess because the filament didn't stick to the build plate.</p> <p>[Laura] That's understandable. As I've mentioned before, there is a handy add-on called an auto-leveler that will help adjust for any nonconformities in your build plate. When you're ready to go to the next slide, click next.</p>	<p>Restrict learner from clicking while the audio is playing.</p> <p>Disable next button until the timeline ends.</p>

	Slide 1.9/ Menu Title: Bed Leveling			Objective: LO2
Layer name:	Visual / Display:	Slide Text:	Narration / Voiceover:	Animation / Interaction:

Base layer – 1.9	<p>Title bar with stylized integrated circuit image as the background with 15% transparency.</p> <p>On the left side of the slide, there are 5 identical sized parallelogram groups. Each group consists of</p> <ul style="list-style-type: none"> • Dark grey parallelogram. Each one is slightly more transparent as you move to the right (see note below). • The text is parallel with the longest sides of the parallelograms, white, and centered. • There is a white background circle with a red outline with a red number corresponding to the information below grouped at the top of each parallelogram. The number has a visited state in dark grey. <ol style="list-style-type: none"> 1. Auto-home (0% transparent) 2. Tighten Screws (10% transparent) 3. Disable Steppers (20% transparent) 4. Level the Bed (25% transparent) 	<p>[Slide Title] Bed Leveling</p> <p>[Slide object text]</p> <ol style="list-style-type: none"> 1. Auto-home 2. Tighten Screws 3. Disable Steppers 4. Level the Bed 5. Re-home & Repeat 	<p>Now that you know the names and functions of the parts of an Ender 3, the next step is to understand how to level a build plate.</p> <p>Having a level build plate is one of the most important steps for successful 3D printing. Click on each section to read more about the 5 steps to level your bed. Some sections will show a video to display the steps as well. When you are finished, click on the same section to collapse the accordion.</p>	<p>The 5 parallelogram groups will fly in from the right with the VO.</p> <p>Next button is disabled until all 5 sections of the accordion have been visited. Use a numerical variable for this.</p> <p>When the user selects parallelogram 1, show the “open” layer.</p> <p>Restrict the learner from clicking while the audio is playing.</p>
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	5. Re-home & Repeat (30% transparent)			
Auto-home open – 1.9a	<p>On base layer, make Parallelograms 2-5 invisible. Duplicate those 4 parallelogram groups on this layer.</p> <p>At the bottom of the “open accordion” space there is a black play button with a red background.</p>	<p>[Slide Text] Auto-Home the printer.</p> <p>The nozzle is positioned as if it is beginning a print.</p> <p>If your printer was leveled previously, this is a good way to check if it is still leveled.</p>	<p>The first step to leveling your bed is to click Auto-home. This process will move the hot end and nozzle to the center of the bed. It will also lower it to the bed where it would normally start printing. This is the best place to start when leveling your bed.</p>	<p>When the timeline starts on this layer, parallelograms 2-5 move on a motion path to the right together, opening the accordion.</p> <p>After the animation is complete, the VO starts. Text fades in all at once.</p> <p>When the user selects the play button, show layer 1.9k</p> <p>When the user selects parallelogram 1 again, show Auto-home close layer.</p> <p>Restrict the learner from clicking while the audio is playing.</p>
Auto-home close – 1.9b	<p>On base layer, make Parallelograms 2-5 invisible. Duplicate those 4 parallelogram groups on this layer.</p> <p>Parallelograms 2-5 start on the right side of the slide (where they are after being opened on open layer).</p>	<p>[Slide Text] Auto-Home the printer.</p> <p>The nozzle is positioned as if it is beginning a print.</p> <p>If your printer was leveled previously, this is a good way to check if it is still leveled.</p>		<p>Text fades out when timeline starts.</p> <p>Parallelograms 2-5 move on a motion path to the right together until they are in the same location as the base layer.</p> <p>The #1 will become a visited state and +1 numerical value when the timeline ends</p> <p>When timeline ends, hide the layer.</p>

Tighten screws -open – 1.9c	<p>On base layer, make Parallelograms 3-5 invisible. Duplicate those 3 parallelogram groups on this layer.</p> <p>At the bottom of the “open accordion” space there is a black play button with a red background.</p>	<p>[Slide Text] Turn the four screws counterclockwise.</p> <p>This increases the distance between the nozzle and the print bed and will help minimize damage to your print bed.</p> <p>If your printer was previously leveled, you may only want to turn these screws a half a turn or a quarter turn.</p>	<p>Next, you will lower the build plate so you don’t run the risk of damaging it while moving the hot end assembly and nozzle. Turn each of the 4 screws under the bed counterclockwise. You may want to turn them until they no longer turn. However, if you are just fine tuning the leveling, a half turn or a quarter turn might be sufficient.</p>	<p>When the timeline starts on this layer, parallelograms 3-5 move on a motion path to the right together.</p> <p>After the animation is complete, the VO starts. Text fades in all at once.</p> <p>When the user selects the play button, show layer 1.9l</p> <p>When the user selects parallelogram 2 again, show Tighten Screws-close layer.</p> <p>Restrict the learner from clicking while the audio is playing.</p>
Tighten screws – close – 1.9d	<p>On base layer, make Parallelograms 3-5 invisible. Duplicate those 3 parallelogram groups on this layer.</p> <p>Parallelograms 3-5 start on the right side of the slide (where they are after being opened on open layer).</p>	<p>[Slide Text] Turn the four screws counterclockwise.</p> <p>This increases the distance between the nozzle and the print bed and will help minimize damage to your print bed.</p> <p>If your printer was previously leveled, you may only want to turn these screws a half a turn or a quarter turn.</p>		<p>Text fades out when timeline starts.</p> <p>Parallelograms 3-5 move on a motion path to the right together until they are in the same location as the base layer.</p> <p>The #2 will become a visited state and +1 numerical value when the timeline ends.</p> <p>When timeline ends, hide the layer.</p>

Disable Steppers – open – 1.9e	<p>On base layer, make Parallelograms 4-5 invisible. Duplicate those 2 parallelogram groups on this layer.</p> <p>At the bottom of the “open accordion” space there is a black play button with a red background.</p>	<p>[Slide Text] Use the interface to disable the steppers.</p> <p>This allows free movement of the hot end assembly and the build plate.</p>	<p>The steps that follow will disable the stepper motors. If you recall, these motors move the X-axis, Y-axis, and Z-axis. By disabling them, you will be able to freely move the hot end assembly side to side and the print bed forward and backward.</p>	<p>When the timeline starts on this layer, parallelograms 4-5 move on a motion path to the right together.</p> <p>After the animation is complete, the VO starts. Text fades in all at once.</p> <p>When the user selects the play button, show layer 1.9m</p> <p>When the user selects parallelogram 3 again, show Disable steppers-close layer.</p> <p>Restrict the learner from clicking while the audio is playing.</p>
Disable steppers -close – 1.9f	<p>On base layer, make Parallelograms 4-5 invisible. Duplicate those 2 parallelogram groups on this layer.</p> <p>Parallelograms 4-5 start on the right side of the slide (where they are after being opened on open layer).</p>	<p>[Slide Text] Use the interface to disable the steppers.</p> <p>This allows free movement of the hot end assembly and the build plate.</p>		<p>Text fades out when timeline starts.</p> <p>Parallelograms 4-5 move on a motion path to the right together until they are in the same location as the base layer.</p> <p>The #3 will become a visited state and +1 numerical value when the timeline ends.</p> <p>When timeline ends, hide the layer.</p>

Level the bed – open – 1.9g	<p>On base layer, make Parallelogram 5 invisible. Duplicate this parallelogram on this layer.</p> <p>At the bottom of the “open accordion” space there is a black play button with a red background.</p>	<p>[Slide Text] You will need a sticky note for the next steps.</p> <p>Place sticky note between bed and nozzle.</p> <p>Turn screw clockwise until a low level of friction is present.</p> <p>Repeat steps for remaining corners and center of bed.</p>	<p>You will need a sticky note for the next few steps. Sticky notes are the perfect thickness to establish the correct spacing between the print bed and the nozzle. Move the nozzle to one corner. Turn the corresponding screw clockwise while moving the sticky note to feel for friction. You should feel a small amount of resistance between the nozzle and bed for the correct spacing. Move the nozzle to the next corner and repeat this process. Do all 4 corners and then check the middle of the bed. It can be a good idea to redo all 4 corners to ensure that there is still the correct amount of spacing.</p>	<p>When the timeline starts on this layer, parallelograms 5 move on a motion path to the right.</p> <p>After the animation is complete, the VO starts. Text fades in all at once.</p> <p>When the user selects the play button, show layer 1.9n</p> <p>When the user selects parallelogram 4 again, show Level the bed-close layer.</p> <p>Restrict the learner from clicking while the audio is playing.</p>
Level the bed – close – 1.9h	<p>On base layer, make Parallelogram 5 invisible. Duplicate this parallelogram on this layer.</p> <p>Parallelogram 5 starts on the right side of the slide (where it is after being opened on open layer).</p>	<p>[Slide Text] You will need a sticky note for the next steps.</p> <p>Place sticky note between bed and nozzle.</p> <p>Turn screw clockwise until a low level of friction is present.</p> <p>Repeat steps for remaining corners and center of bed.</p>		<p>Text fades out when timeline starts.</p> <p>Parallelogram 5 move on a motion path to the right until it is in the same location as the base layer.</p> <p>The #4 will become a visited state and +1 numerical value when the timeline ends.</p> <p>When timeline ends, hide the layer.</p>

Re-home & repeat – open – 1.9j	<p>Create a new thinner grey parallelogram (similar to #5) and place it below Parallelogram group #5.</p>	<p>[Slide Text] Rehome the printer.</p> <p>Repeat all the previous steps with limited screw turning to fine tune the leveling of your build plate.</p>	<p>The final step of leveling your bed is to rehome the printer and repeat all of those steps. You will want to ensure that the spacing in different areas of the bed are uniform.</p>	<p>When the timeline starts on this layer, the thin parallelogram moves on a motion path to the right.</p> <p>After the animation is complete, the VO starts. Text fades in all at once.</p> <p>When the user selects parallelogram 5 again, show Re-home & Repeat-close layer.</p> <p>Restrict the learner from clicking while the audio is playing.</p>
Re-home & repeat – close – 1.9j	<p>Duplicate the thin parallelogram from the “open” layer on this layer.</p> <p>The thin parallelogram starts on the right side of the slide (where it is after being opened on open layer).</p>	<p>[Slide Text] Rehome the printer.</p> <p>Repeat all the previous steps with limited screw turning to fine tune the leveling of your build plate.</p> <p>Click NEXT to continue to a knowledge check.</p>	<p>[Laura] Now that you’ve learned the 5 steps, I’m going to have you test your understanding with a knowledge check. When you’re ready, click Next to continue.</p>	<p>Text fades out when timeline starts.</p> <p>When timeline beings, show the “click next to continue” text, then at the end of the timeline hide the layer.</p> <p>The thin parallelogram moves on a motion path to the right until it is in the same location as the base layer, then disappears.</p> <p>The #5 will become a visited state and +1 numerical value when the timeline ends.</p> <p>When timeline ends, hide the layer.</p>

Lightbox 1 – 1.9k	<p>Use the same background as slide 1.6 and title bar with appropriate text.</p> <p>The video “auto-home” is centered on the slide with the same background as slide 1.3.</p>	[Slide Title] Auto-home		<p>The media begins playing when the timeline begins.</p> <p>Begin media when the timeline starts. When the user clicks the (x), show layer 1.9a.</p>
Lightbox 2 – 1.9l	<p>Use the same background as slide 1.6 and title bar with appropriate text.</p> <p>The video “tighten screws” is centered on the slide with the same background as slide 1.3.</p>	[Slide Title] Tighten Screws		<p>The media begins playing when the timeline begins.</p> <p>Begin media when the timeline starts. When the user clicks the (x), show layer 1.9c.</p>
Lightbox 3 – 1.9m	<p>Use the same background as slide 1.6 and title bar with appropriate text.</p> <p>The video “disable steppers” is centered on the slide with the same background as slide 1.3.</p>	[Slide Title] Disable Steppers		<p>The media begins playing when the timeline begins.</p> <p>Begin media when the timeline starts. When the user clicks the (x), show layer 1.9e.</p>
Lightbox 4 – 1.9n	<p>Use the same background as slide 1.6 and title bar with appropriate text.</p> <p>The video “level the bed” is centered on the slide with the same background as slide 1.3.</p>	[Slide Title] Level the Bed		<p>The media begins playing when the timeline begins.</p> <p>Begin media when the timeline starts. When the user clicks the (x), show layer 1.9g.</p>

	Slide 1.10/ Title: Knowledge Check			Objective: LO2
Layer	Visual / Display:	Slide Text:	Narration / Voiceover:	Animation / Interaction:

Base Layer – 1.10	<p>Title bar and dark grey background are present.</p> <p>Text is white.</p>	<p>[Slide Title] Knowledge Check</p> <p>[Slide Text] There are five steps to successfully level your build plate. Drag the steps to place them in the correct order.</p> <p>[answer choices – in correct order]</p> <ul style="list-style-type: none"> • Auto-home • Lower build plate • Disable steppers • Level bed with sticky note • Repeat steps 	<p>[Laura] There are five steps to successfully level your build plate. Drag the steps to place them in the correct order.</p>	<p>This is a drag and drop sequence question.</p> <p>Title and question flies in from the left.</p> <p>Drag and drop items fly in from the bottom after the question is present on the slide.</p> <p>Next button goes to slide 1.12. Prev button goes to slide 1.6.</p>
Correct Layer – 1.10a	<p>Create a new slide background by covering the default slide with the dark grey background. Add Laura on the left of the slide and Cole on the right.</p> <p>The continue button has a dark red background with the “title” font.</p>	<p>[Slide Text] That’s right! You correctly ordered the bed leveling steps.</p>	<p>[Laura] Woo hoo! You got them all correct! Great job!</p>	
Try Again Layer – 1.10b	<p>Create a new slide background by covering the default slide with the dark grey background. Add Laura on the left of the slide and Cole on the right.</p> <p>The Try Again button has a dark red background with the “title” font.</p>	<p>[Slide Text] That is incorrect. Please try again.</p>	<p>[Laura] You didn’t quite get them all. Try one more time and see if you can get them in the right order.</p>	

Incorrect Layer – 1.10c	<p>Create a new slide background by covering the default slide with the dark grey background. Add Laura on the left of the slide and Cole on the right.</p> <p>The continue button has a dark red background with the “title” font.</p>	<p>[Slide Text]</p> <p>You did not select the correct response.</p> <p>In order to successfully level the bed, you need to Auto-home first, then lower the bed, next disable the steppers, level the bed with a sticky note, and finally, repeat all the steps until the spacing is uniform.</p>	<p>[Laura]</p> <p>Unfortunately, you didn’t get them correct. Remember the steps!</p> <ol style="list-style-type: none"> 1. Auto-home 2. Lower the bed 3. Disable the steppers 4. Level the bed 5. Rehome and repeat 	
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Topic: How to fine tune the printer (LO 2)

	Slide 1.11/ Title: Fine Tuning Your Printer			Objective: LO2
	Visual / Display:	Slide Text:	Narration / Voiceover:	Animation / Interaction:

Base Layer – 1.11	<p>Title bar with dark grey background and 3 square images distributed horizontally across the slide on the top portion of the slide.</p> <p>Laura’s character will be on the left side of the screen while Cole is on the right side of the screen.</p> <p>Images should be set up as a 2x2 grid. Pictures should be cropped to be all the same dimensions.</p> <ul style="list-style-type: none"> • Image 1 – Under extrusion • Image 2 – Draft • Image 3 – Nozzle image <p>Each image has a hover state (to indicate to the learner that it is interactive) and visited state where the image is greyed out.</p>	<p>[Slide Title] Fine Tuning Your Printer</p> <p>[Slide Text] Click on each picture to reveal some common problems that can be fixed with fine tuning your printer. When you have finished, click the text box.</p>	<p>[Laura] Sometimes a level build plate is all you need to successfully print. Unfortunately, many times, you will need to fine tune your printer.</p> <p>[Cole] I’ve found that out the hard way, unfortunately!</p> <p>[Laura] First, it will be important to understand what issues are occurring and what is causing them. Below are 3 different printing problems that can lead to frustration with this hobby. Click on each picture to reveal some common problems that can be fixed with fine tuning your printer.</p>	<p>When the timeline starts on this slide, show layer 1.12d for the scenario component.</p> <p>When the learner clicks on each picture, the card will reveal information about what adjustments can fix the problem.</p> <p>The next button is disabled until the user has viewed all 4 layers with information.</p> <p>Next button goes to slide 1.13. Prev button goes to slide 1.11.</p>
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Under Extrusion – 1.11a	<p>The under extrusion image is present on this slide but hide the one on the base layer.</p> <p>A medium red rectangle is the same height and width as all 3 images. In the top right corner, there is a black (X) with a hotspot placed over it.</p> <p>All text is white on this layer.</p> <p>Place the numbered list between the image and the video.</p> <p>The video will play in the remainder of the space within the red box.</p> <p>Hide the “click on each...” text on the base layer.</p>	<p>[Slide Text] Under Extrusion</p> <p>How to Calibrate e-steps</p> <ol style="list-style-type: none"> 1. Measure 100 mm filament & mark 2. Extrude 100 mm 3. Measure to mark 4. Calculate 5. Adjust e-steps 6. Repeat 	<p>[Laura] When your printer is under extruding, the easiest way to solve this problem is to calibrate your e-steps.</p> <p>The printer thinks it is extruding 100 mm, but in reality, your printer is extruding less. To fix this issue, you need to calibrate the e-steps.</p> <p>Step 1. . Measure 100 mm from the extruder and mark filament. Step 2. . After heating the hot end, extrude 100 mm using the printer settings. Step 3. . Measure the distance from the extruder to the mark. Step 4. Calculate correct e-steps by multiplying the current value by 100, then dividing by the measured distance. Step 5. Adjust your e-steps to reflect the difference. Step 6. Repeat Steps 1-4 until it successfully extrudes 100 mm.</p> <p>[Cole] That sounds easy enough. I’ve seen some of those gaps in my prints, so I bet my e-steps need to be adjusted.</p>	<p>When the image is clicked, the text box wipes in from the left and expands to cover up the other 3 images.</p> <p>While the video is playing, Cue the VO with the video and fade in the numbers as they reach that part of the video.</p> <p>Restrict the learner from clicking while the audio/video is playing.</p> <p>When learner clicks the (x), hide the layer</p>
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Draft – 1.11b	<p>The Draft image is present on this slide but hide the one on the base layer.</p> <p>A medium red rectangle is the same height and width as all 3 images. In the top right corner, there is a black (X) with a hotspot placed over it.</p> <p>All text is white on this layer.</p> <p>Place the bulleted list between the draft image and the 3 images below.</p> <p>3 images – placed within the remaining open space for the rectangle:</p> <ul style="list-style-type: none"> - Cardboard enclosure - PVC frame enclosure - Factory made enclosure <p>Hide the “click on each...” text on the base layer.</p>	<p>[Slide Text] Draft</p> <ul style="list-style-type: none"> • Print lifts • Draft nearby • Enclosures – use cardboard, build, or buy • Make sure size is accurate 	<p>[Laura] When your print lifts from the bed, you may have a draft near your printer. The best way to fix it is to put it in an enclosure.</p> <p>You can build an enclosure using a cardboard box, PVC frame with some insulating material, or you can purchase one made specifically for your printer.</p> <p>If you choose to build an enclosure, make sure that the bed can move forward and backward freely without hitting the walls of the enclosure.</p> <p>[Cole] I like the idea of building my own enclosure.</p> <p>[Laura] Just remember the temperatures at which the printer works can lead to a fire hazard, so be thoughtful of which materials you choose.</p> <p>[Cole] Oh, that’s a great point. Thanks for the reminder!</p>	<p>The draft image slides to the left on a motion path to make it fit directly above the first image on the base layer.</p> <p>The rectangle wipes in from the left to take up the space of the 3 images on the base layer.</p> <p>The bulleted list fades in with VO, as do the 3 pictures. Restrict the learner from clicking while the audio is playing.</p> <p>When the user clicks the (x), hide the layer.</p>
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<p>Nozzle – 1.11c</p>	<p>The Nozzle image is present on this slide but hide the one on the base layer.</p> <p>A medium red rectangle is the same height and width as all 3 images. In the top right corner, there is a black (X) with a hotspot placed over it.</p> <p>Arrows point to blobby section of image and the area where there are gaps. The last arrow points to the smooth section.</p> <p>All text is white on this layer.</p> <p>Place the bulleted list in the red rectangle on the right side, leaving room for the arrows.</p> <p>Place the video for how to adjust z-offset</p> <p>Hide the “click on each...” text on the base layer.</p>	<p>[Slide Text]</p> <p>Nozzle needs to be adjusted</p> <ul style="list-style-type: none"> • Too close - blobby • Too far – gaps • Just right – smooth without gaps • Adjust z-offset • Tune-Probe Z-offset • Fine tune while printing 	<p>[Laura]</p> <p>This image shows places where the nozzle is too close, too far, and just the right distance from the bed.</p> <p>When the print appears blobby or clumpy, like you see here, the nozzle is too close. This occurs because the nozzle is moving through the previous layer and remelting that filament.</p> <p>[Cole]</p> <p>That explains why I was having so many issues with my first layer!</p> <p>[Laura]</p> <p>If you get strings of filament that aren’t touching as you can see in this area, this indicates that your nozzle is too far from the bed. This occurs because the filament is cooling before adhering to the bed and it isn’t being squished down.</p> <p>Lastly, the area where the print appears smooth and there are no gaps is the perfect adjustment for your nozzle. You can see that here. If you have either of the above problems, here’s how to solve it.</p> <p>First, you will start with the main menu of your printer. Then click Tune. From there, you will scroll to Probe Z Offset. If your nozzle is too close, you want to increase the number. If the nozzle is too far away, you want to decrease the number. Keep in mind that when if the numbers are negative, smaller numbers have increasing decimals. It is easiest to make these adjustments while the printer is running.</p>	<p>The nozzle image slides to the left on a motion path to make it fit directly above the first image on the base layer.</p> <p>The rectangle wipes in from the left to take up the space of the 3 images on the base layer.</p> <p>The bulleted list fades in with VO.</p> <p>The arrows will Fly in from the bottom with the VO.</p> <p>Restrict the learner from clicking while the audio is playing.</p> <p>When the user clicks the (x), hide the layer.</p>
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Scenario – 1.11d	<p>Laura is on the left while Cole is on the right. Use the same setup as Slide 1.4.</p> <p>Speech bubbles are present for each character.</p>	<p>[Slide Text] [Cole] Thank you so much for going through all those steps with me. I missed a few of those steps, so it is no wonder that I wasn't have success.</p> <p>[Laura] I'm glad that the bed leveling section was helpful. Now we are going to discuss how to fine tune your printer. The way that the filament extrudes can show us a lot about what your printer is doing. We will go through a few different areas where you can fine tune your printer.</p> <p>[Cole] Yeah. I've seen some recommendations for this, but I had no idea where to start. This is super helpful!</p>	<p>[Cole] Thank you so much for going through all those steps with me. I missed a few of those steps, so it is no wonder that I wasn't have success.</p> <p>[Laura] I'm glad that the bed leveling section was helpful. Now we are going to discuss how to fine tune your printer. The way that the filament extrudes can show us a lot about what your printer is doing. We will go through a few different areas where you can fine tune your printer.</p> <p>[Cole] Yeah. I've seen some recommendations for this, but I had no idea where to start. This is super helpful!</p>	<p>When the timeline ends on this layer, hide this layer.</p> <p>The text fades in with the VO.</p> <p>Restrict the learner from clicking on anything while the audio is playing.</p>

Topic: Types of Filaments (LO 3)

	Slide 1.12 / Title: Types of Filaments			Objective: LO3
Layer	Visual / Display:	Slide Text:	Narration / Voiceover:	Animation / Interaction:

<p>Base Layer – 1.12</p>	<p>Title bar with dark grey background.</p> <p>On the left side of the slide there is a half circle in medium red. The text inside of the circle fits the curve of the circle and is white.</p> <p>There are 4 circles. Each small circle is red with a wide white outline and white text:</p> <ul style="list-style-type: none"> • PLA • PETG • ABS • TPU <p>The circles are equally spaced from the edge of the circle and vertically distributed.</p> <p>The “Click next...” text has 2 states – normal is dark grey (same as the background), and continue (text turns white so it is now visible).</p>	<p>[Slide Title] Types of Filaments</p> <p>[Bullet points]</p> <ul style="list-style-type: none"> • Several different types of filament • Unique characteristics • Choose for specific model use <p>[Slide Text] Click on each type of filament to learn more about these characteristics.</p> <p>Click Next to continue to a knowledge check</p>	<p>[Laura] Once you have become comfortable with adjusting the physical aspects of your printer, you may want to explore different types of filaments.</p> <p>There are several different types of filament that 3D printing hobbyists can use. Each type of filament has a unique set of characteristics, so it is important to know what they are so you can choose the correct one for your model. Click on each type of filament to learn more about these characteristics.</p>	<p>When the timeline starts on this slide, show layer 1.13e.</p> <p>The title bar flies in from the left.</p> <p>The circle flies in from the left. After the circle is in place, the text fades in on the circle.</p> <p>The small red circles are the interaction and has a hover state that glows red to indicate that it is interactive.</p> <p>Each of the circles fly in from the bottom left corner, starting with PLA, then PETG, ABS, and finally TPU.</p> <p>When the user clicks on the PLA circle, show the PLA layer.</p> <p>When the user clicks on the PETG circle, show the PETG layer.</p> <p>When the user clicks on the ABS circle, show the ABS layer.</p> <p>When the user clicks on the TPU circle, show the TPU layer.</p> <p>Restrict the learner from clicking while audio is playing.</p> <p>The next button is disabled until all 4 types of filament layers have been visited.</p>
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PLA – 1.12a	<p>All objects on the base layer are visible.</p> <p>White text on the right side of the screen with a title and then bullet points.</p>	<p>[Slide Text]</p> <p>PLA</p> <ul style="list-style-type: none"> • Polylactic Acid • Low melting temperature • Provides strength • Comes in a variety of colors and finishes • Biodegradable • Does not withstand high temperatures 	<p>[Laura]</p> <p>Short for Polylactic Acid, PLA is the best filament for beginners. It has a low melting temperature, and it can provide strength in prints. It comes in many different colors and finishes: matte, silky, and regular. One benefit is that this filament is biodegradable. However, if you want a model to withstand higher temperatures, such as the interior of a vehicle in the summer, this filament is not the one to use.</p> <p>[Cole]</p> <p>Huh. I didn’t know that PLA was biodegradable. I suppose that makes sense since they say that prints that are meant to last a long time shouldn’t be printed in PLA.</p>	<p>The text for Filament type fades in when the timeline starts.</p> <p>Each bullet point wipes to the right with the VO.</p> <p>Restrict the learner’s ability to click until the audio is finished.</p> <p>When the user clicks outside of PLA, hide the layer.</p>

<p>PETG – 1.12b</p>	<p>All objects on the base layer are visible.</p> <p>White text on the right side of the screen with a title and then bullet points.</p>	<p>[Slide Text]</p> <p>PETG</p> <ul style="list-style-type: none"> • Polyethylene Terephthalate Glycol • Use in many plastics • Food safe • Durable • Melts between 230° - 245° C • Withstands higher environmental temperatures 	<p>[Laura]</p> <p>This filament is something you are very familiar with. Short for Polyethylene terephthalate glycol, Pet G is used in many plastic products, such as water bottles and take out cups. Pet G is food safe and has a higher durability. Since it melts between 230 and 245°C, it can withstand environments with higher temperatures.</p> <p>[Cole]</p> <p>I've seen some videos where people take a 2 liter bottle and melt it into their own filament. Maybe someday....</p>	<p>The text for Filament type fades in quickly when the timeline starts.</p> <p>Each bullet point wipes to the right with the VO.</p> <p>Restrict the learner's ability to click until the audio is finished.</p> <p>When the user clicks outside of PETG, hide the layer.</p>
<p>ABS – 1.12c</p>	<p>All objects on the base layer are visible.</p> <p>White text on the right side of the screen with a title and then bullet points.</p>	<p>[Slide Text]</p> <p>ABS</p> <ul style="list-style-type: none"> • Frequently used for injection molding • Acrylonitrile butadiene styrene • Chemical resistant • Impact resistant • Rigid • Finish with acetone vapor to smooth 	<p>[Laura]</p> <p>Second in popularity, ABS is most frequently used for injection molding, but has many uses for 3D printing. Acrylonitrile butadiene styrene (ABS) has chemical resistance, toughness, and impact resistance, but is also rigid. The interesting thing about ABS is that you can use acetone vapor to help smooth the surface after printing.</p> <p>[Cole]</p> <p>The finishing aspect is one of the things that I am really looking forward to trying. The prints look amazing after that's done. So much better than sanding it a million times!</p>	<p>The text for Filament type fades in quickly when the timeline starts.</p> <p>Each bullet point wipes to the right with the VO.</p> <p>Restrict the learner's ability to click until the audio is finished.</p> <p>When the user clicks outside of ABS, hide the layer.</p>

<p>TPU – 1.12d</p>	<p>All objects on the base layer are visible.</p> <p>White text on the right side of the screen with a title and then bullet points.</p>	<p>[Slide Text]</p> <p>TPU</p> <ul style="list-style-type: none"> • Thermoplastic Polyurethane • Flexible • Impact resistant • Durable • Direct drive extruder recommended 	<p>[Laura]</p> <p>New models that provide flexibility require the use of TPU. Thermoplastic polyurethane (TPU) is helpful for models that require flexibility but are also impact resistant and durable. In order to use TPU filament, many hobbyists recommend having a direct drive extruder upgrade on your printer.</p> <p>[Cole]</p> <p>I've heard great things about using a direct drive extruder. I'm not sure that is something that I will do, but I appreciate the introduction!</p>	<p>The text for Filament type fades in quickly when the timeline starts.</p> <p>Each bullet point wipes to the right with the VO.</p> <p>Restrict the learner's ability to click until the audio is finished.</p> <p>When the user clicks outside of TPU, hide the layer.</p>
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Scenario – 1.12e	<p>Use the same set up as the other scenario slides.</p> <p>Laura is on the left side of the slide while Cole is on the right side.</p> <p>Speech bubbles are present for each character.</p>	<p>[Laura] What type of filament have you been using?</p> <p>[Cole] I have only used PLA because I figured if I couldn't successfully print with PLA, why would I further my frustration with the other types?</p> <p>[Laura] That makes sense. We are going to take a few minutes to go over the different types of filaments that the Ender 3 can use. This way when you are fully comfortable with PLA, you can expand to the other types of filaments that are available.</p> <p>[Cole] I've read some information about ABS which sounds really intriguing. I know nothing about the other types that are available though.</p> <p>[Laura] Great! Let's get started.</p>	<p>[Laura] What type of filament have you been using?</p> <p>[Cole] I have only used PLA because I figured if I couldn't successfully print with PLA, why would I further my frustration with the other types?</p> <p>[Laura] That makes sense. We are going to take a few minutes to go over the different types of filaments that the Ender 3 can use. This way when you are fully comfortable with PLA, you can expand to the other types of filaments that are available.</p> <p>[Cole] I've read some information about ABS which sounds really intriguing. I know nothing about the other types that are available though.</p> <p>[Laura] Great! Let's get started.</p>	<p>When the timeline on this layer ends, hide the layer.</p> <p>Text fades in with VO.</p> <p>Restrict the learner from clicking on anything while the audio is playing.</p>

	Slide 1.13/ Title: Knowledge Check			Objective: LO3
Layer	Visual / Display:	Slide Text:	Narration / Voiceover:	Animation / Interaction:

Base Layer – 1.13	<p>Title bar with dark grey background.</p> <p>The text is white.</p> <p>The same circles from the previous slide are found horizontally distributed near the center of the slide. Connected to the bottom center of each circle is a white rounded rectangle about 3 times the size of the circle itself. Make this rounded rectangle tall enough to fit 3 of the drag and drop items. The rounded rectangle overlaps the white boarder on the circle a little.</p> <p>Centered on the slide below the white rounded rectangles are the drag and drop items with a light grey background and white text. These objects have a correct and incorrect state.</p>	<p>[Slide Title] Knowledge Check</p> <p>[Slide Text] Which filament would you choose for a project that requires these qualities? Drag each quality to the correct filament type. Each filament type will have more than one quality to place.</p> <p>[choices w/ correct answer] PLA –</p> <ul style="list-style-type: none"> • Biodegradable • Strength <p>PETG –</p> <ul style="list-style-type: none"> • Food safe • Withstand harsh conditions <p>ABS –</p> <ul style="list-style-type: none"> • Chemical resistant • Finish with acetone vapor • Impact resistant w/ rigidity <p>TPU –</p> <ul style="list-style-type: none"> • Flexible • Durability w/ flexibility 	<p>[Laura] Which filament would you choose for a project that requires these qualities? Drag each quality to the correct filament type. Each filament type will have more than one quality to place. You will have two chances to get these correct.</p>	<p>This is a drag and drop interaction.</p> <p>Title flies in from the left while the text for the question flies up from the bottom.</p> <p>After the above objects are in place, the circles with rounded rectangles fade in on the slide.</p> <p>The drag and drop choices fade in on the slide shortly after the rounded rectangle objects are in place.</p> <p>Next is disabled on this slide. The submit button is present. Prev goes to slide 1.13.</p>

Correct- 1.13a	<p>Create a new slide background by covering the default slide with the dark grey background. Add Laura on the left of the slide and Cole on the right.</p> <p>The continue button has a dark red background with the “title” font.</p>	<p>[Slide Text] Correct</p> <p>Congratulations! You got them all correct! PLA is biodegradable and strong. PETG is food safe and can withstand harsh conditions. ABS is chemical resistant, rigid and impact resistant, while TPU is durable and flexible.</p>	<p>[Laura] Way to go! You really understand the different characteristics of filament types!</p>	<p>When the learner clicks continue they will go to slide 1.15.</p>
Try Again – 1.13b	<p>Create a new slide background by covering the default slide with the dark grey background. Add Laura on the left of the slide and Cole on the right.</p> <p>The Try Again button has a dark red background with the “title” font.</p>	<p>[Slide text] Incorrect</p> <p>You didn’t quite get all the correct answers. Look for the red ones and rearrange them.</p>	<p>[Laura] You’re on the right track, but you didn’t quite get them all. Try again!</p>	<p>When the learner clicks Try again, hide the layer.</p>
Incorrect – 1.13c	<p>Create a new slide background by covering the default slide with the dark grey background. Add Laura on the left of the slide and Cole on the right.</p> <p>The continue button has a dark red background with the “title” font.</p>	<p>[Slide Text] Incorrect</p> <p>The correct answers are: PLA: biodegradable & strength PETG: Food safe & withstands harsh conditions ABS: Chemical resistant, finish with acetone vapor, & impact resistant with rigidity TPU: Flexible & Durability with flexibility</p>	<p>[Laura] Unfortunately, you didn’t get them all correct. Remember that PLA is biodegradable and provides strength while PETG is food safe and can withstand harsh conditions. ABS and TPU are similar with durability, but ABS is chemical resistant while TPU is flexible.</p>	<p>When the learner clicks continue, go to slide 1.15.</p>

Topic: Print Settings (LO 4)

	Slide 1.14/ Menu Title: Print Settings (Part I)			Objective: [#]LO4
Layer name	Visual / Display:	Slide Text:	Narration / Voiceover:	Animation / Interaction:
Base Layer 1.14	<p>Title bar is present with the integrated circuit image as the background.</p> <p>On the left side of the slide there is a black arrow pointing left. On the right side, there is a black arrow pointing right.</p> <p>On a dark red rectangle in the middle of the screen, include this list. (this rectangle repeats on the following layers)</p> <ul style="list-style-type: none"> • Bed temperature • Nozzle temperature • Bed adhesion • Supports • Layer height 	<p>[Slide title] Print Settings – Part I</p> <p>[Slide text] The five most important settings that you can find in your slicer are:</p> <ul style="list-style-type: none"> • Bed temperature • Nozzle temperature • Bed adhesion • Supports • Layer height 	<p>[Laura] When adjusting the physical aspects of your printer just doesn't get you the results you want, it is time to start adjusting settings in your slicer.</p> <p>Slicers are applications that will take a 3D model and turn it into g-code, which is the file format that your printer understands. Each of the settings below are found in all slicers.</p> <p>[Cole] Those slicer settings are intimidating! I've only really played with layer height and supports. I'm ready to learn more!</p> <p>[Laura] Great! Click on the left or right arrow to learn about these most common print settings. When you've visited all 5 sections, click next to continue to the next slide.</p>	<p>This will be a carousel interaction.</p> <p>Title flies in from the left.</p> <p>The rectangle will fly in from the bottom at the same time.</p> <p>The arrows fly in from each side with the VO.</p>

<p>Bed Temperature – 1.14a</p>	<p>Include a screen shot of Cura slicer settings on the top middle of the medium red rectangle</p> <p>Text is in a bulleted list and is white. Where the text shows a nested bullet, the same should appear on the screen.</p>	<p>[Slide Subtitle] Bed Temperature</p> <p>[Slide Text]</p> <ul style="list-style-type: none"> • Varies depending on the type of filament • Check the filament spool for recommendation • General Guidelines: <ul style="list-style-type: none"> ○ PLA: 50 – 70°C ○ PETG: 70 °C ○ TPU: >60 °C ○ ABS: 110 °C • Temperature Tower 	<p>[Laura] The settings for bed temperature will vary depending on the type of filament you are using. You will want to check the recommended settings on your spool of filament, but some general guidelines are as follows: PLA 50-70 degrees Celsius Pet G: 70 degrees Celsius TPU: < 60 degrees Celsius ABS: 110 degrees Celsius</p> <p>[Cole] This is great! I knew the other filaments needed different bed temps, but I didn't know what they were.</p>	<p>Each bullet point fade in with the VO.</p>
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<p>Nozzle Temp – 1.14b</p>	<p>Include a picture of a temp tower top center of the rectangle.</p> <p>Text is in a bulleted list and is white. Where the text shows a nested bullet, the same should appear on the screen.</p>	<p>[Slide Subtitle] Nozzle Temperature</p> <p>[Slide Text]</p> <ul style="list-style-type: none"> Depending on which type of filament you are using, the nozzle setting will vary. Print a temperature tower which changes temperature at various heights. Common temperature ranges by filament are: <ul style="list-style-type: none"> PLA: 190-210 °C PETG: 230-245 °C TPU: 220-250 °C <p>ABS: 220-240 °C</p>	<p>Depending on which type of filament you are using, the nozzle setting will vary. The best way to determine the perfect temperature is to print a temperature tower. This 3D model will change the hot end temperature at various heights so you can see the temperature at which it prints the best.</p> <p>Common temperature ranges by filament are: PLA: 190-210 degrees Celsius Pet G: 230-245 degrees Celsius TPU: 220-250 degrees Celsius ABS: 220-240 degrees Celsius</p> <p>You can download a file for a temperature tower. This will change the temperature of the nozzle based on the height and will give you a good idea at which temperature your filament prints best.</p> <p>[Cole] I've heard of temp towers before. I wasn't sure what their function was, so I'm glad you went over that.</p>	<p>Each bullet point will wipe towards the right with the VO.</p>
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<p>Bed Adhesion – 1.14c</p>	<p>Include images – 3 tiles aligned across the top of the rectangle. Place a dark grey rectangle place holder for these 3 images.</p> <ul style="list-style-type: none"> - Skirt - Brim - Raft <p>Text is in a bulleted list and is white. Where the text shows a nested bullet, the same should appear on the screen.</p>	<p>[Slide Subtitle] Bed Adhesion</p> <p>[Slide Text]</p> <ul style="list-style-type: none"> • One of the most frustrating problems to troubleshoot • Can waste a lot of filament • Settings you can choose from: <ul style="list-style-type: none"> ○ None – large surface area on project ○ Skirt – a thin layer surrounds print without touching ○ Brim – wide ribbon around edges of model <p>Raft- a few layers of filament under a model</p>	<p>[Laura] Bed adhesion may be one of the most frustrating problems to troubleshoot. If your print does not stick to the bed, you may find yourself wasting a lot of filament.</p> <p>There are a few different settings you can choose from: None – your project has a large surface area on the bottom and may be able to stick on its own. Skirt – a thin layer of filament that surrounds your print but does not touch it. This helps to prime the extruder. Brim – this is similar to the skirt, except that it will touch the outer edges of your model. This helps improve the adhesion to the build plate and is especially helpful if your model has thin areas on the build plate. Raft – Provides a few layers of filament under the entire model and is discarded after the print. Printing with 3D filament will give you many different options for your project.</p> <p>[Cole] The raft feels like such a waste of filament, but I understand why it is useful. The skirt also seems like a weird feature since it doesn't actually touch the print, but so many pictures that I see online only have the skirt.</p>	<p>Each bullet point will wipe towards the right with the VO.</p> <p>Skirt image flies in from the left Brim flies in from the bottom Raft flies in from the right – all fly in with the VO.</p>
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Supports – 1.14d	<p>Show an image with supports under the overhang of the model. This image is top center in the rectangle with the text below it.</p> <p>Text is in a bulleted list and is white. Where the text shows a nested bullet, the same should appear on the screen.</p>	<p>[Slide Subtitle] Supports</p> <p>[Slide Text]</p> <ul style="list-style-type: none"> You may need to have your slicer generate supports. Temporary filament Ensures that overhangs (over 45°) can print successfully Becomes a threaded mess Without supports, it will lead to frustration and wasted filament. 	<p>[Laura] Depending on the model that you are trying to print, you may need to have your slicer generate supports. Supports are temporary filament that is printed to ensure that overhangs can print successfully. These are removed after the print is finished and are discarded. This feature is important for projects that have overhangs of more than 45°. When you have large overhangs, the printer will try to add filament to nothing – the filament will still extrude, but with no surface, it becomes a threaded mess. Failure to add supports to projects with these overhangs will ultimately lead to frustration and wasted filament.</p> <p>[Cole] I've made that mistake a time or two. Such a mess and wasted filament. These supports makes me wish there was an easy way to recycle the waste filament produced.</p>	Each bullet point will wipe towards the right with the VO.
Layer Height – 1.14e	<p>Show images of what a detailed file with varying layer heights looks like - .12, .16, .20, .28 These 4 images can be placed in a 2x2 grid at the top center of the rectangle</p> <p>Text is in a bulleted list and is white. Where the text shows a nested bullet, the same should appear on the screen.</p>	<p>[Slide Subtitle] Layer Height</p> <p>[Slide Text]</p> <ul style="list-style-type: none"> Consider the detail of the model Small, fine details – 0.12 mm Functional with few details – 0.2 – 0.28 mm <p>Smaller layer height leads to longer print times.</p>	<p>[Laura]When you choose layer height, you need to keep in mind how much detail there is within the model that you are printing. If the model has many small, fine details, you will want to print at a lower layer height, such as 0.12 mm. If your print is more functional with few details, you may be able to get away with a 0.2mm or even 0.28mm layer height. Also keep in mind that when you choose a small layer height, the time it takes for your printer to complete the process will be significantly longer due to an increased number of layers.</p>	Each bullet point will wipe towards the right with the VO.

	Slide 1.15/ Title: Print Settings (Part II)			Objective: LO4
Layer	Visual / Display:	Slide Text:	Narration / Voiceover:	Animation / Interaction:
Base Layer – 1.15	<p>Title bar is present with the integrated circuit image as the background.</p> <p>On the left side of the screen, there is 5 medium red buttons, dark grey outline with white text. Each button will have a normal, selected (light red) and visited (light grey) state.</p> <ul style="list-style-type: none"> • Retraction • Speed • Infill • Initial layer speed • Initial fan speed <p>To the right of the buttons, there is a rectangle that takes up most of the rest of the slide. It is dark grey with 5% transparency. This is where the text for each layer will be placed.</p>	<p>[Slide Title] Print Settings – Part II</p> <p>[Slide Text] Print settings can help you improve your print quality.</p> <p>Settings are found in slicers.</p> <p>Click on each setting to learn more.</p>	<p>[Laura] We've covered the 5 most frequently used settings in the slicer. Now we are going to cover some of the more obscure settings. Keep in mind that there are a LOT more settings than just these 10 presented in the course. As you become more comfortable with your printer and adjusting print settings, you may find yourself more interested in those settings.</p> <p>In the meantime, we will be covering retraction, speed, infill, initial layer speed, and the initial fan speed.</p> <p>[Cole] I've used infill before, but I haven't messed with the speed or retraction settings yet, and those initial fan and layer speeds are just out of my league!</p> <p>[Laura] Well, hopefully when we are done here, you'll feel more comfortable with those settings.</p> <p>When you're ready, click on each of the boxes to learn more about each setting.</p> <p>When you are finished, click next to move onto the knowledge check.</p>	<p>Title bar flies in from the left.</p> <p>The buttons fly in from the left as one large group while the grey rectangle also flies in, making it appear to wipe to the right across the slide.</p> <p>The white text on the grey rectangle will fly in from the bottom after the buttons and rectangle are in place.</p> <p>The next button is disabled until all layers have been visited.</p> <p>When the learner clicks on each individual button, show the corresponding layer.</p> <p>The learner is restricted from clicking on other buttons while the audio on each layer is playing.</p> <p>Next button goes to slide 1.16. Prev button goes to slide 1.14.</p>

<p>Speed – 1.15a</p>	<p>Place the image of different finishes on a single model to show the difference between slower speeds and faster speeds.</p> <p>Text is in a bulleted list and is white. Where the text shows a nested bullet, the same should appear on the screen.</p>	<p>[Slide Subtitle] Speed</p> <p>[Slide Text]</p> <ul style="list-style-type: none"> • Settings for speed may change • The slower you print, the better the finish of your final product will be. • Silk has the best finish at slower speeds. • May also vary by filament • The range is between 45 mm/s and 60 mm/s. • Higher speeds are acceptable if the finish is unimportant. 	<p>[Laura] The settings for speed may change based on a few situations.</p> <p>The slower you print, the better the finish of your final product will be. If you are using a silk PLA, the shine will display best at slower speeds.</p> <p>Printing speeds may also vary by filament. Since most 3D printing hobbyists will use PLA, the range is between 45 mm per second and 60 mm per second. Some individuals will print at higher speeds, especially if the finish of the model is not important.</p> <p>[Cole] So you're saying I can make my printer go a lot faster if I don't care if the plastic is shiny? Let's go! This is a game changer. I'm always so impatient for the printing process to complete.</p> <p>[Laura] You'll want to be careful though because if it goes too fast, the layers may not adhere properly, so your model might be weaker.</p> <p>[Cole] Good to know. Thanks for that information.</p>	<p>Each bullet point will wipe towards the right with the VO.</p>
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Retraction – 1.15b	<p>Include an image with a lot of stringing between different parts of the print.</p> <p>Text is in a bulleted list and is white. Where the text shows a nested bullet, the same should appear on the screen.</p>	<p>[Slide Subtitle] Retraction</p> <p>[Slide Text]</p> <ul style="list-style-type: none"> • Retraction is how filament is pulled back as the nozzle moves between parts on a layer. <ul style="list-style-type: none"> ○ Retraction speed – the speed at which the filament is retracted ○ Retraction minimum travel – reduces retractions on models with many small parts ○ Retraction distance – length of filament retracted • Reduces Stringing 	<p>[Laura]</p> <p>When 3D printing, retraction settings will allow you to determine how filament is pulled back as the nozzle moves between parts on a layer. There are a number of different settings that you can change to get the best possible print quality.</p> <p>Retraction Speed – the speed at which the filament is retracted Retraction Minimum Travel – this depends on the distance between parts. It will allow the printer to reduce the number of retractions, especially if there are many small parts. Retraction Distance – the length of filament retracted</p> <p>You can experiment with these settings to reduce stringing on your print.</p> <p>[Cole]</p> <p>So is there an easy way to get rid of the strings that are present on models without sanding it?</p> <p>[Laura]</p> <p>Many people will use a few short blasts from a heat gun to melt those tiny filament threads. What remains can often be smoothed down with fingers or they disappear completely. Just don't burn your fingers if the model got too hot.</p> <p>[Cole]</p> <p>Great tip! I never thought of a heat gun!</p>	<p>Each bullet point will wipe towards the right with the VO.</p>
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<p>Infill – 1.15c</p>	<p>Text is in a bulleted list and is white. Where the text shows a nested bullet, the same should appear on the screen.</p>	<p>[Slide Subtitle] Infill</p> <p>[Slide Text]</p> <ul style="list-style-type: none"> • Are you seeking strength and durability, or purely decorative? • Strength/durability – large percentage model is more solid – 100% no gaps • More decorative – low infill such as 15% • Low infill reduces the filament used 	<p>[Laura] To determine the infill that you need for your project, you must first ask yourself if you are seeking strength and durability, or something that is going to be purely decorative.</p> <p>If you need strength and durability, you will want a larger infill percentage. If you choose 100% infill, your model will be solid with no gaps inside.</p> <p>Most models that are more decorative can get away with infill as low as 15%. This reduces the amount of filament used during printing.</p> <p>[Cole] This makes sense – if I have a model that is just going to sit on a shelf, then I don't need much for infill, but if I am going to make something that is function, like a hook or something that needs to support weight, I should go with a larger infill percentage.</p>	<p>Each bullet point will wipe towards the right with the VO.</p>
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Initial Layer speed – 1.15d	<p>Text is in a bulleted list and is white. Where the text shows a nested bullet, the same should appear on the screen.</p>	<p>[Slide Subtitle] Initial Layer Speed</p> <p>[Slide Text]</p> <ul style="list-style-type: none"> • Very first layer of filament • The use of rafts can reduce need for this. • Ample time reduces too many complications. • Slower speed minimizes vibrations. • Allows the nozzle and extruder to reduce clumps or gaps • Recommended speed – 20 mm/s 	<p>[Laura] The initial layer is the very first layer of filament that is being placed on the build plate. If you are using a raft, this setting is not quite as important.</p> <p>When you slow down the speed of your initial layer, you provide ample time for the filament to go down without too many complications. The slower speed on this layer will help minimize vibrations from the printer and it allows the nozzle and extruder to reduce issues such as clumps or gaps.</p> <p>Many hobbyists will choose 20 mm per second as a speed for the first layer.</p> <p>[Cole] Maybe this is another place where I’ve been failing. I’m not sure what my initial layer speed is in my slicer. Do you know if 20mm/s is the default?</p> <p>[Laura] I believe it is, but you will want to double check your settings to make sure. If your prints aren’t sticking, you could try slowing down your initial layer, adding a raft, or increasing your bed temp.</p> <p>[Cole] There’s so much to know. I feel like my brain is going to explode with all of this new information.</p>	<p>Each bullet point will wipe towards the right with the VO.</p>
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Initial Fan speed – 1.15e	Text is in a bulleted list and is white. Where the text shows a nested bullet, the same should appear on the screen.	<p>[Slide Subtitle] Initial Fan Speed</p> <p>[Slide Text]</p> <ul style="list-style-type: none"> • The first layers of your project, you may want to adjust the fan speed. • Turn off the fan for the initial layer. • Filament cools slowly – strong base layer • Reduce warping on the build plate 	<p>[Laura] As your printer begins printing the first layers of your project, you may want to adjust the fan speed. How your first few layers of your project print will determine some of the most important parts to having a successful print.</p> <p>Many hobbyists will turn off the fan for the initial layer. This allows the filament to cool slowly, providing a strong base layer. This can also help reduce your project from warping on the build plate.</p> <p>[Cole] I've noticed that my printer is pretty loud right from the beginning of a print. I wonder if that's just the fan from the power supply, or if it is a combination of the fans from the hot end and the power supply. I will have to investigate this further!</p>	Each bullet point will wipe towards the right with the VO.
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	Slide 1.16/ Title: Knowledge Check			Objective: LO4
Layer	Visual / Display:	Slide Text:	Narration / Voiceover:	Animation / Interaction:

Base Layer – 1.16	<p>Title bar with dark grey background.</p> <p>Text on the matching pieces is the same dark red color as the title bar.</p>	<p>[Slide Title] Knowledge Check</p> <p>[Slide Text] Which slicer setting would you change to begin troubleshooting the following problems? Match the setting with the problem.</p> <p>[matching options with correct answer]</p> <ul style="list-style-type: none"> • Bed adhesion – print isn't sticking to the bed • Infill – print is weak and breaks easily • Retraction – stringing between model parts • Speed – silky finish looks dull • Initial fan speed – print is warping off the bed • Supports – strings occur on model overhang 	<p>Which slicer setting would you change to begin troubleshooting the following problems?</p>	<p>This is a matching interaction.</p> <p>Title bar flies in from the left while the question text and the matching box flies in from the bottom.</p> <p>Next button is hidden. Prev button goes to slide 1.15. Submit button is visible.</p>
Correct – 1.16a	<p>Create a new slide background by covering the default slide with the dark grey background. Add Laura on the left of the slide and Cole on the right.</p> <p>The continue button has a dark red background with the “title” font.</p>	<p>[Slide Text] Correct</p> <p>That's right! You selected the correct response.</p>		

Try Again – 1.16b	<p>Create a new slide background by covering the default slide with the dark grey background. Add Laura on the left of the slide and Cole on the right.</p> <p>The Try Again button has a dark red background with the “title” font.</p>	<p>[Slide Text] Incorrect</p> <p>That is incorrect. Please Try again.</p>		
Incorrect – 1.16c	<p>Create a new slide background by covering the default slide with the dark grey background. Add Laura on the left of the slide and Cole on the right.</p> <p>The continue button has a dark red background with the “title” font.</p>	<p>[Slide Text] Incorrect</p> <p>You did not select the correct response.</p> <p>Here are the correct answers:</p> <p>Bed Adhesion – Print doesn’t stick to the bed Infill – Print is weak and breaks easily Retraction – Stringing between model parts Speed - Silky finish looks dull Initial fan speed – Print warps off the bed Supports – Strings occur by overhang</p>		

Assessment

	Slide 1.17/ Title: Graded Quiz			Objective: N/A
Layer	Visual / Display:	Slide Text:	Narration / Voiceover:	Animation / Interaction:

Base Layer - 1.17	Title bar with dark grey background.	[Slide Title] Graded Quiz	[Laura] Now it is time for you to show what you have learned. The following quiz has five questions. You must earn an 80% or higher to pass. To earn an 80%, you must have four correct answers.	Title bar flies in from the left.
	Image of a printer 3D printing an object on the left side of the slide.	[Slide Text] <ul style="list-style-type: none"> The following quiz has five questions, worth 10 points each. 		The image flies in from the bottom.
	Light red chevron shapes in front of bullet points.	<ul style="list-style-type: none"> You must earn an 80% or higher to pass. 	Click the begin quiz when you are ready to start.	The bullet points fly in from the right with VO.
	Begin quiz button is dark red rounded rectangle with "title" font. It is placed lower right corner of the slide.	<ul style="list-style-type: none"> To earn an 80%, you must earn 40 points or get four questions correct. You will have unlimited attempts to reach a passing score on this assessment. 		Next button is hidden. Prev button goes to slide 1.16.
				Begin Quiz button fades in with VO.

	Slide 1.18/ (hidden from menu)			Objective: LO2
Layer	Visual / Display:	Slide Text:	Narration / Voiceover:	Animation / Interaction:
Base Layer – 1.18	Dark grey background with title bar.	[Slide Title] Question 1	What is the first step to level your build plate?	This is a multiple-choice interaction.
	Place Cole on the right side of the slide.	[Slide Text] What is the first step to level your build plate?		Title bar is present at the beginning of timeline. Question text fades in with the VO.
	Text is in white.	<ul style="list-style-type: none"> Turn the screws clockwise Auto-home [correct] Turn the screws counter clockwise Disable the steppers 		Answer options fade in after the question text is in place.
				Next and Prev button are hidden.
				Submit button is present.

	Slide 1.19/ (hidden from menu)			Objective: LO2
Layer	Visual / Display:	Slide Text:	Narration / Voiceover:	Animation / Interaction:

Base Layer – 1.19	Dark grey background with title bar.	[Slide Title] Question 2	What is the best tool to use to determine if the spacing between your build plate and nozzle is just right?	This is a multiple-choice interaction.
	Place Cole on the right side of the slide. Text is in white.	[Slide Text] What is the best tool to use to determine if the spacing between your build plate and nozzle is just right? <ul style="list-style-type: none"> • Printer paper • Cardstock • Sticky note [correct] • Receipt paper 		

	Slide 1.20/ (hidden from menu)			Objective: LO3
Layer	Visual / Display:	Slide Text:	Narration / Voiceover:	Animation / Interaction:

Base Layer – 1.20	Dark grey background with title bar.	[Slide Title] Question 3	What are some of the qualities of different types of filaments? Match the filament type with the set of characteristics.	This is a matching interaction. Title bar is present at the beginning of timeline. Question text fades in with the VO. Answer options fade in after the question text is in place. Next and Prev button are hidden. Submit button is present.
	Place Cole on the right side of the slide. Text is white.	[Slide Text] What are some of the qualities of different types of filaments? Match the filament type with the set of characteristics. [matching options with correct answers] TPU – This filament is flexible but provides durability. PLA – This filament is versatile, providing strength while still being biodegradable. ABS – This filament is durable and rigid and can be finished with acetone vapor after printing. PETG – This filament is food safe, strong, and can withstand chemicals and harsh conditions.		

	Slide 1.21/ (hidden from menu)			Objective: LO4
Layer	Visual / Display:	Slide Text:	Narration / Voiceover:	Animation / Interaction:

Base Layer – 1.21	Dark grey background with title bar.	[Slide Title] Question 4	What setting would you manipulate in order to provide a brim around your project? Choose the best answer.	This is a multiple-choice interaction.
	Place Cole on the right side of the slide. Text is white.	[Slide Text] What setting would you manipulate in order to provide a brim around your project? Choose the best answer. <ul style="list-style-type: none"> • Initial layer print speed • Initial layer fan speed • Supports • Infill • Bed Adhesion [correct] • Layer Height 		

	Slide 1.22/ Title: Question 5 (hidden from menu)			Objective: LO1
Layer	Visual / Display:	Slide Text:	Narration / Voiceover:	Animation / Interaction:

Base Layer – 1.22	Dark grey background with title bar.	[Slide Title] Question 5	What are the functions of the different parts of an Ender 3 printer? Drag the function to match with the part.	This is a matching interaction. Title bar is present at the beginning of timeline. Question text fades in with the VO. Answer options fade in after the question text is in place. Next and Prev button are hidden. Submit button is present.
	Place Cole on the right side of the slide. Text is white.	[Slide Text] What are the functions of the different parts of an Ender 3 printer? Drag the function to match with the part. [matching options with correct answers] Extruder – Advances and retracts the filament during printer Hot end assembly – provides heat at the specified temperature to melt the filament. Interface – This part can be used to fine tune the printer, such as calibrating the e-steps. Stepper motor – There are 3 of these – they move the bed, Z-axis, and hot end to create a 3D model. Motherboard – Inside a small black box, there is an integrated circuit where all components are controlled. Build Plate – This heated surface is where 3D models are produced.		

	Slide 1.23/ Title: Quiz Results (hidden from menu)			Objective: LO4
Layer	Visual / Display:	Slide Text:	Narration / Voiceover:	Animation / Interaction:

Base Layer – 1.23	<p>Title bar is present with dark grey background.</p> <p>In the lower center of the slide, there is a lighter grey box with “your score” and “passing score: [reference]%</p>	<p>[Slide Title] Quiz Results</p> <p>[Slide Text] YOUR SCORE</p> <p>PASSING SCORE: [reference]%</p>		Navigation is disabled on this slide. Learner will use “summary,” “review quiz,” and “try again” buttons for navigation.
Success – 1.23a	<p>Create a new slide background by covering the default slide with the dark grey background. Add Laura on the left of the slide and Cole on the right.</p> <p>The continue and review button have a dark red background with the “title” font.</p>	<p>[Slide Text] Nice job, you passed! You are well on your way to understanding the basics of 3D printing. The information in this course has prepared you to troubleshoot some of the most common problems during 3D printing.</p>	<p>[Laura] Amazing! Time to celebrate! You passed! You are well on your way to understanding the basics of 3D printing. The information in this course has prepared you to troubleshoot some of the most common problems during 3D printing.</p>	
Failure – 1.23b	<p>Create a new slide background by covering the default slide with the dark grey background. Add Laura on the left of the slide and Cole on the right.</p> <p>The Try Again and Review button have a dark red background with the “title” font.</p>	<p>[Slide Text] Sorry, you didn’t pass. Take some time to review your quiz results. When you are ready, click Retry Quiz to try again.</p>	<p>[Laura] Sorry, you didn’t pass. Take some time to review your quiz results. When you are ready, click Retry Quiz to try again.</p>	

Summary

	Slide 1.24/ Title: Summary			Objective: N/A
Layer	Visual / Display:	Slide Text:	Narration / Voiceover:	Animation / Interaction:

Base Layer – 1.24	<p>Title bar with integrated circuit image as the background.</p> <p>The 4 learning objectives are present in the same format as on the learning objective slide.</p> <p>There is a dark grey parallelogram on the left half of the slide with 20% transparency.</p>	<p>[Slide Title] Summary</p> <p>[Slide Text]</p> <ul style="list-style-type: none"> • Identify the different components and the function of these parts on an Ender 3 printer. • Recognize the steps needed to correctly level the build plate and fine tune the printer. • Describe the different types of filaments used in 3D printing. • Manipulate settings in the slicer to obtain the desired printed object. 	<p>[Laura]</p> <p>That was a lot of information to digest! Hopefully you’ve found it helpful to learn these key pieces of information to help you be successful with your new hobby.</p> <p>Now that you have reached the end of this course, you should be able to</p> <ul style="list-style-type: none"> • Identify the different components and the function of these parts on an Ender 3 printer. • Recognize the steps needed to correctly level the build plate and fine tune the printer. • Describe the different types of filaments used in 3D printing. • Manipulate settings in the slicer to obtain the desired printed object. <p>[Cole]</p> <p>Definitely! I feel so much more prepared now. I wish there was a little cheat sheet that I could use to help me remember this after awhile.</p> <p>[Laura]</p> <p>You’re in luck! In the resources section of this course you can find a PDF that you can print out if you’d like.</p>	<p>Title bar flies in from the left. Trapezoid flies in from the right. Next button is disabled until the VO has completed.</p> <p>Next button goes to slide 1.24. Prev button goes to slide 1.22.</p>
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Conclusion

	Slide 1.25/ Title: Congratulations!			Objective: N/A
Layer	Visual / Display:	Slide Text:	Narration / Voiceover:	Animation / Interaction:
Base Layer – 1.25	<p>Title bar is present with the red/black integrated circuit as the background for the slide. The background image has 20% transparency. There is a dark grey rectangle with the text on it that takes up most of the slide open space.</p> <p>Complete button is a rounded rectangle in dark red with white “title” text.</p>	<p>[Slide Title] Congratulations!</p> <p>[Slide Text] Through your hard work, you have learned some of the most important aspects of 3D printing.</p> <p>The more that you work with your printer, the easier it will be to understand the issues that it presents you.</p> <p>Click complete to finish this course.</p>	<p>[Laura] Congratulations!</p> <p>Through your hard work, you have learned some of the most important aspects of 3D printing.</p> <p>The more that you work with your printer, the easier it will be to understand the issues that it presents you.</p> <p>Click complete to finish this course.</p>	<p>Title bar flies in from the left.</p> <p>The grey box with white text fades in directly after the title bar.</p> <p>The complete button appears with VO.</p> <p>Navigation is disabled on this slide.</p>