1. While 3D printers are theoretically capable of creating anything, there are practical considerations that should be made when you're designing parts you intend to print.

2. This video is going to go over the most important features and specifications of 3D printers, and how they impact printed parts. At the end of the video, you should be able to look at the specifications of a printer, determine what is and isn't important, and figure out if a printer is can create your model, without modification. Later videos will go over how to optimize your design for printing.

3. One of the most obvious and important specifications of a printer is how big it is. If you want to print a model larger than the printer you're working with, you're going to have a bad time. Always make sure that your model will fit in the build area: its length, width, and height have to be smaller than that of the build area.

4. 3D printers typically work best with smaller parts. Larger parts have a tendency to warp: the lower layers of plastic cool and shrink while the top layers are still warm and larger. The difference in size causes lower layers to lift off the printbed, or higher levels to separate, or delaminate. This effect becomes more pronounced with larger parts.

5. The diameter of the nozzle is another important feature. Many printers will let you change nozzles between prints, but for a single print, you'll have to use the same nozzle. The nozzle diameter and z-axis resolution of your printer determine the level of detail your printed parts will have: a finer resolution and smaller nozzle diameter will create a higher-quality part.

6. However, higher-quality parts take longer: at a higher resolution, more layers are required, and because the nozzle is small, less plastic can be extruded per second. When you're looking at printers, don't be wowed by the X-Y axis resolution. On most printers, this number is basically meaningless.

7. If you look at the image on the right, you can see why. Printed parts aren't made of long, thin tubes: the plastic comes out of a round hole and squishes out. The degree to which the plastic squishes out is somewhat unpredictable. It's consistent, and it isn't a huge deformation, so you can create detailed parts that are the right size, but the squishing out probably overwhelms the precision of the X-Y axis. The images on the left, however, show the importance of the z-axis resolution. The part on the right looks a lot smoother than the one on the left. This is because they selected a smaller layer height when printing the model.

8. Printers usually come with recommended layer heights, but this is a setting you can generally change each time you print. The layer height is the height of each individual layer of plastic, or the distance the z-axis moves up each layer. Generally speaking, you want your layer height to be greater than the resolution of the z-axis, and less than the nozzle width.

   Let's say you're printing a model with thin features in the z-axis: a 1mm base, 0.4 mm platform, and a 0.2mm surface finish. You want to print it quickly, but you want the features to be the right thickness. So, what layer height should you select? We'll assume the z-axis resolution is negligible. Feel free to pause the video and think about it.

   For a 0.4mm nozzle, you want to select a layer height that's between zero and 0.4mm. You also

want to make sure that you pick a layer height that all of your thin features are evenly divisible by: if we picked 0.3mm, the platform would either be 0.3mm or 0.6mm thick. So, a height of 0.2mm makes sense.

For a 0.2mm nozzle, you might think a height of 0.2mm will be fine, but you want to go smaller: the plastic comes out that thick, and if your printer rises up that much each time, there's a chance the layers won't stick together. 0.1mm makes more sense.

9. Finally, materials. The two plastics most used in 3D printing are ABS, or acrylonitrile butadiene styrene, and PLA, or poly-lactic acid. They look fairly similar, and for a lot of parts they'd both work just as well as each other. I'll talk more about different materials in another video, but for now, the most important things to know are which plastics the printer you're using is capable of printing.

10. There are a wide variety of materials out there. In this picture, there's coloured and uncoloured PLA, nylon, wood, ABS, and a wax-based material. The two things that impact whether or not your printer can handle exotic materials are how hot the nozzle can go, and whether or not it has a heated bed. If you want to use an exotic material, check what temperature it needs to be extruded at, and if it needs a heated bed. For example, ABS needs a heated bed, where PLA doesn't, and flows at as low as 190 degrees Celsius, compared to ABS' 230.

    One final consideration to make when looking at a printer is what parts it's created previously. If you know you need something with a high degree of detail, see if the printer has created similarly-detailed parts before. Look at previous parts for warping, discolouration, or anything else that's important to you. Compare them to the design, and talk to the people that printed them.

    If you can't find previous parts, look online, on hobbyist websites, for people who have used the printer. Avoid the manufacturer's website: they know their printer very well, and they'll only post the best pictures.

11. So, in this video, we've talked about the most important features of printers. Here are some questions to ask yourself when you're designing a part or going to print.

    Next time, we'll talk about how to print fine details and small features well.