



3D Printing


(which I consider to be a legitimate form of Computer Graphics display...)



Oregon State University

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3D Printing date: 11/20/2024

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In the Beginning, All Manufacturing was "Subtractive"



1. The whirling drill bit follows a 3D path around a block of metal, wax, or wood
2. Chips fly
3. A block of metal becomes a part

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Today's 3D Printing Process

"3D Printing" is generally considered to be some sort of "Additive" process in which layers of material get deposited on previous layers. (Additive manufacturing is also sometimes called *Stereolithography*.)

The current frenzy in 3D Printing consists mostly of desktop systems that deposit layers of molten plastic, like this one. But there are many others.



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Examples of 3D Printing using a Variety of Materials



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Portland's Laika uses Color 3D Printing to Make Faces for Stop-motion Movies



From *Kubo and the Two Strings*

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The 3D Printing Geometry File

3D Printers are fed a file called an "STL File", which lists all the triangles in the object. All 3D CAD-ish systems (as well as TinkerCad, Thingiverse, and Blender) can produce this type of file for you.

```

solid
  facet normal 0.00 0.00 -1.00
    outer loop
      vertex -2.000000 -2.000000 0.250000
      vertex -1.980000 -1.980000 0.250000
      vertex -1.980000 -2.000000 0.250000
    endloop
  endfacet
  facet normal 0.00 0.00 -1.00
    outer loop
      vertex -2.000000 -2.000000 0.250000
      vertex -2.000000 -1.980000 0.250000
      vertex -1.980000 -1.980000 0.250000
    endloop
  endfacet
  ...
endsolid
  
```


In this particular file, these coordinates were in units of inches.

Some 3D Printers still use **inches**, but most now seem to use **millimeters**.

Check! It matters!

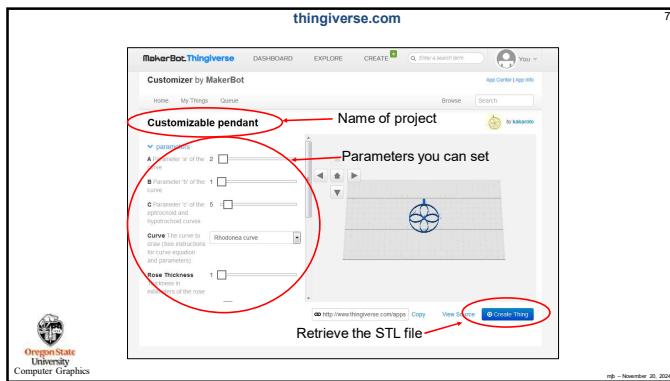
Note: there are 25.4 mm/inch

If you sent this file to a millimeter-based 3D printer, the part would come out very, very tiny! ☹

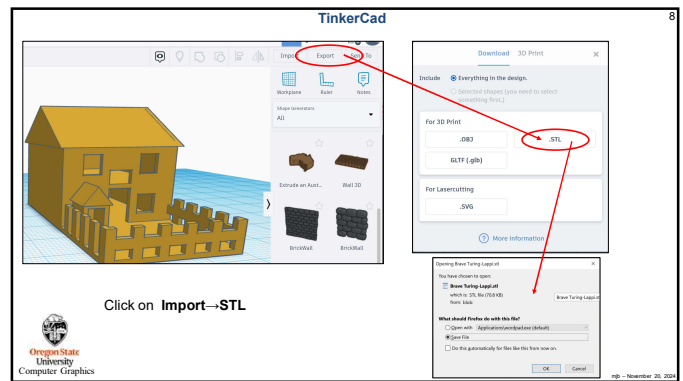
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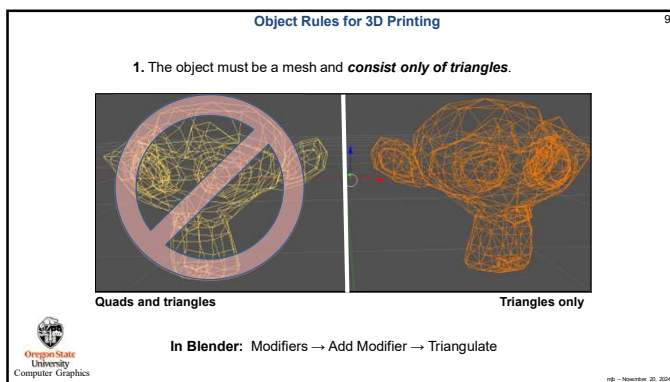
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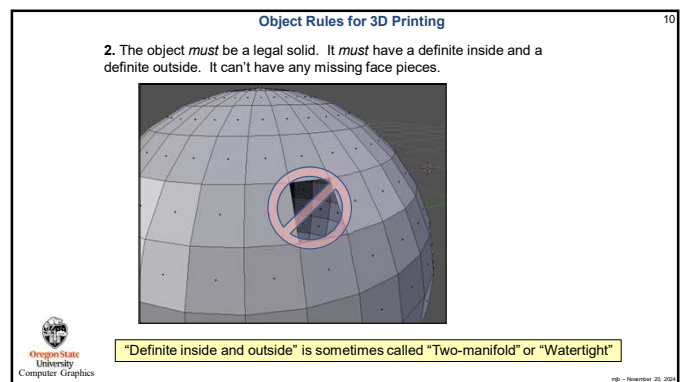
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8



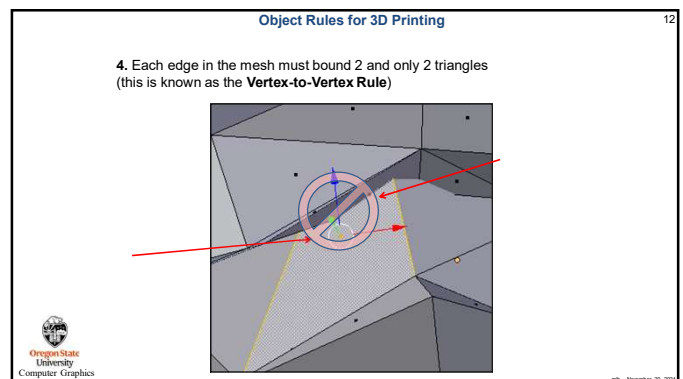
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10

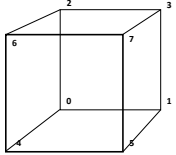


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The Simplified Euler's Formula* for Legal Solids

$$F - E + V = 2$$


F Faces
E Edges
V Vertices

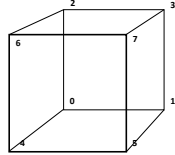
For a cube: $6 - 12 + 8 = 2$

*sometimes called the Euler-Poincaré formula

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The Full Euler's Formula* for Legal Solids

$$F - E + V - L = 2(B - G)$$


F Faces
E Edges
V Vertices
L Inner Edge Loops (within faces)
B Bodies
G Genus (number of through-holes)

For a cube: $6 - 12 + 8 - 0 = 2(1 - 0)$

*sometimes called the Euler-Poincaré formula

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Advice on 3D Printing

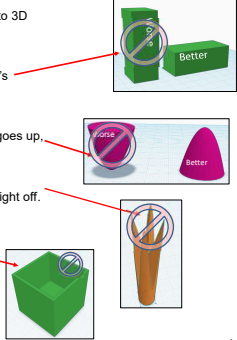
Don't make the part too big to start – it will take a long time to 3D print. It's nice if you can fit several models in a single run.

Try to rotate the part so the smallest dimension is vertical. It's stronger that way, and it builds faster.

The 3D Printer will like it better if the part gets smaller as it goes up, not the other way around.

Don't design the part with long, thin edges. They will snap right off.

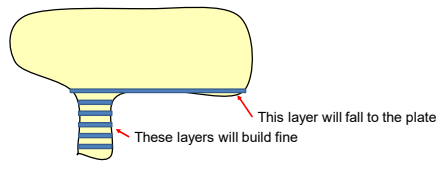
Don't make walls too thin – they will break.



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Watch Out for Overhangs!



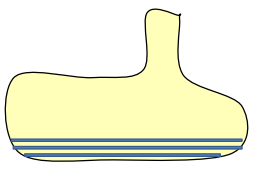
This layer will fall to the plate

These layers will build fine

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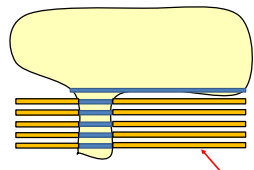
Note that, if you build this object upside-down, it will probably be fine



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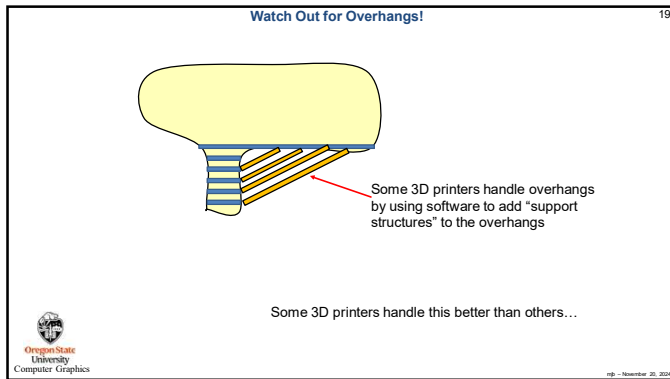
Watch Out for Overhangs!



Some 3D printers handle overhangs by leaving unused material in place to support the overhangs

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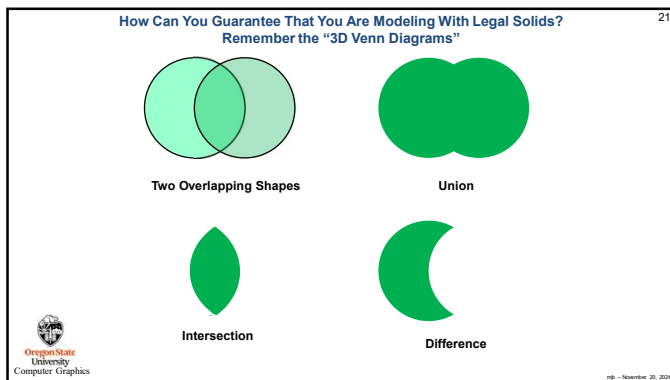
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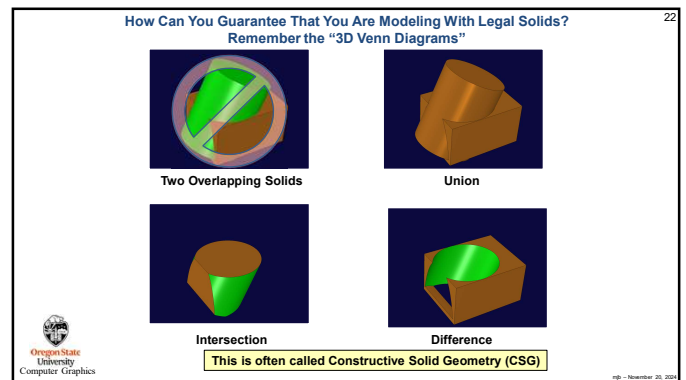
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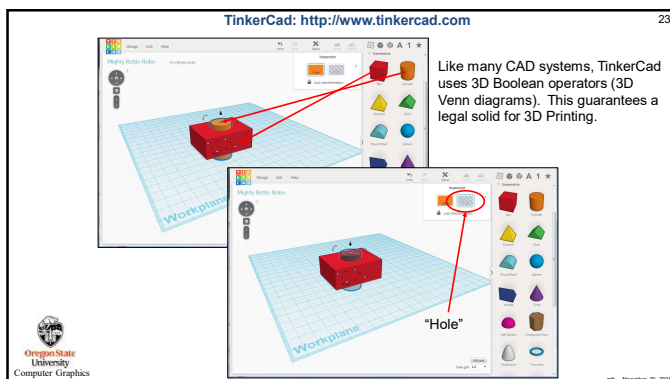
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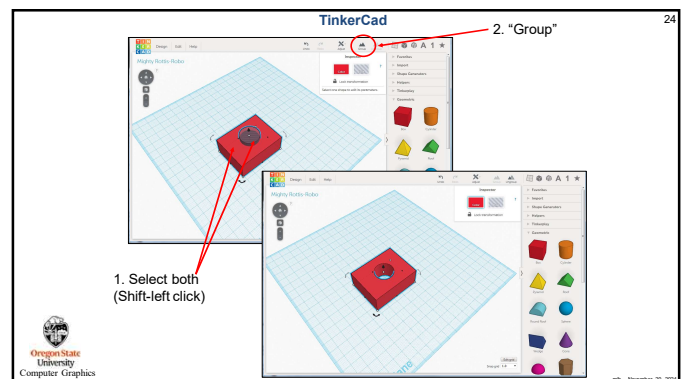
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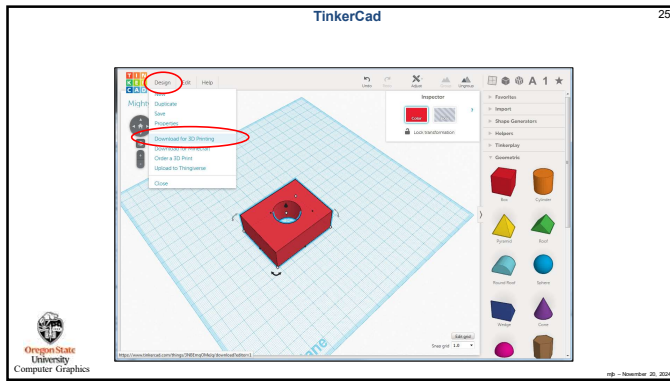
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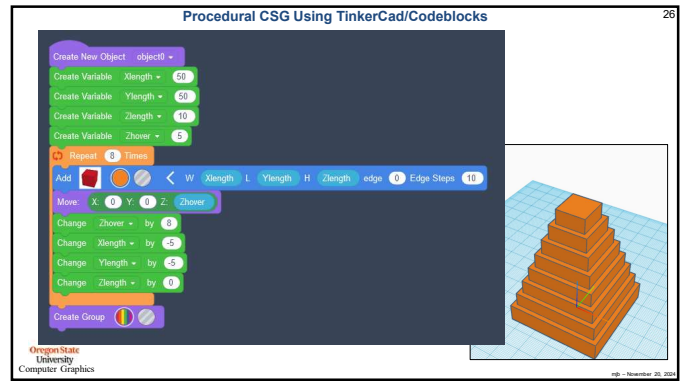
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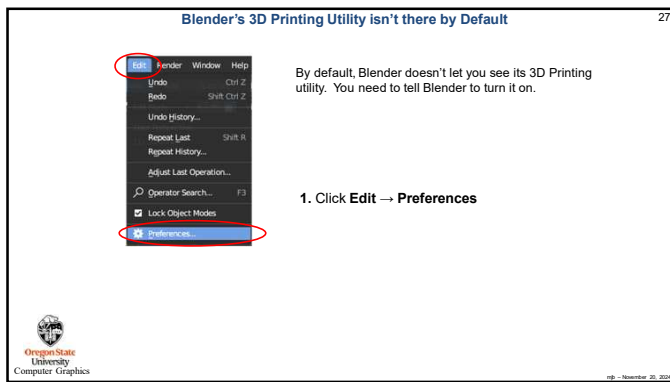
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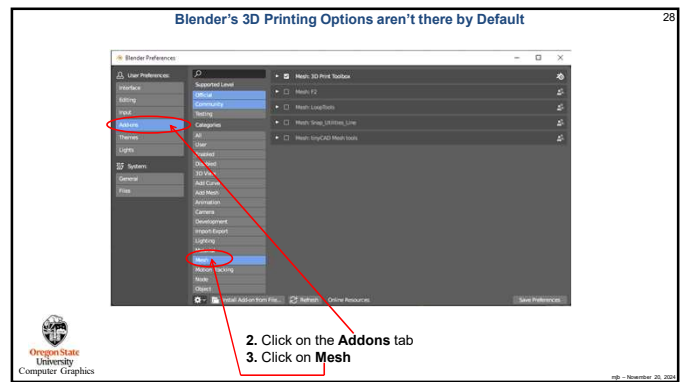
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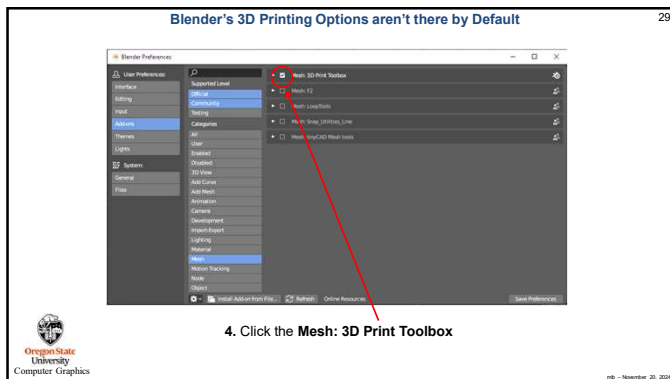
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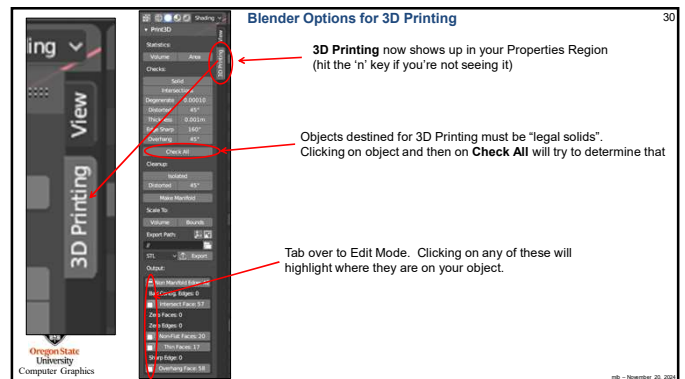
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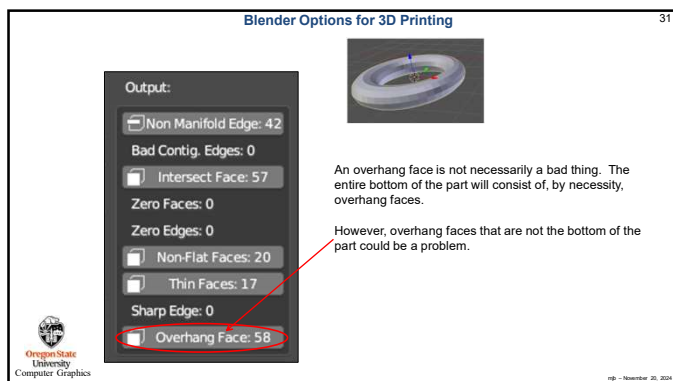
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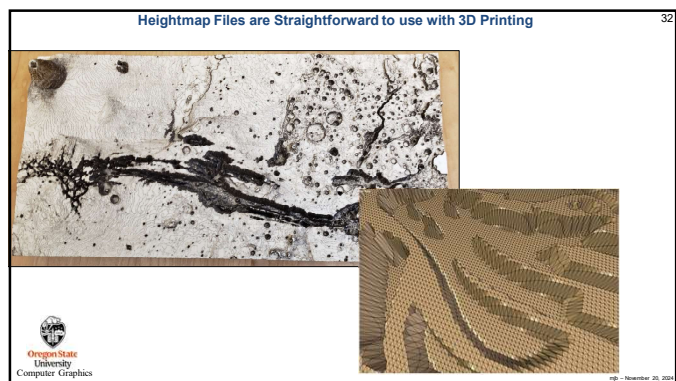
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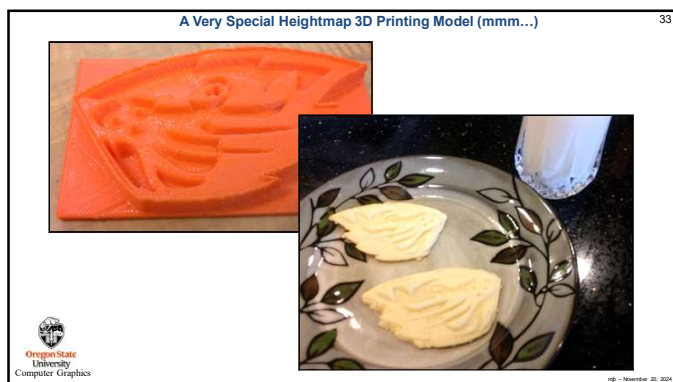
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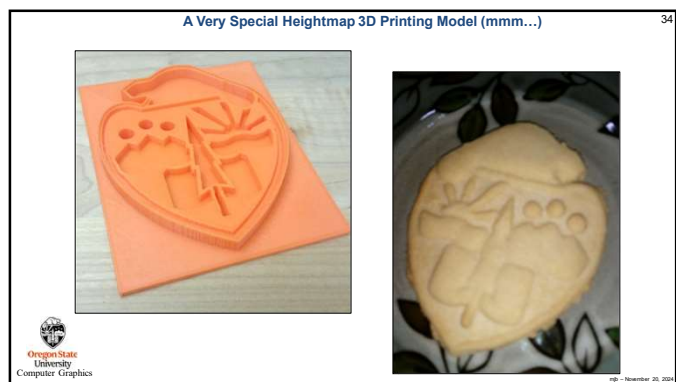
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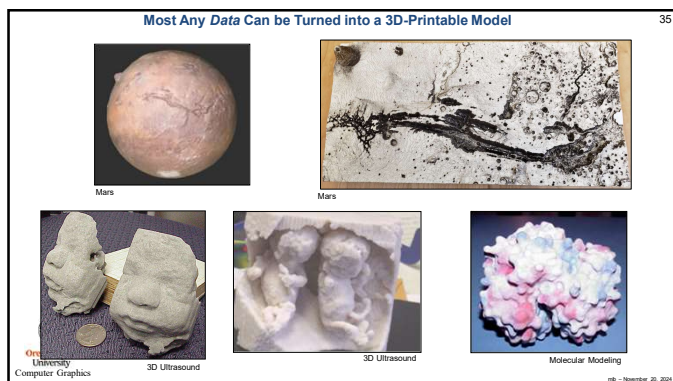
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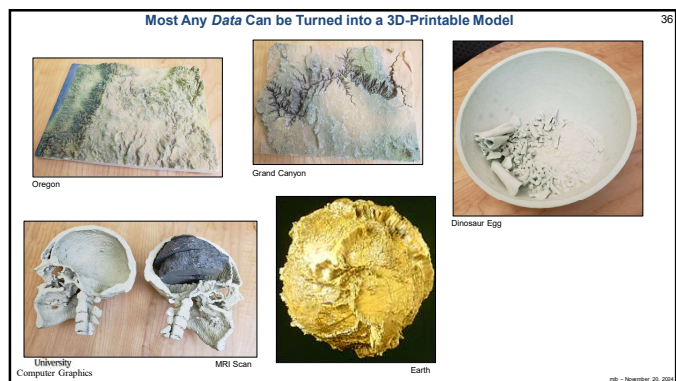
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The OSU Library Has Four 3D Printers for Student Use

To watch the OSU Library's 3D Printers, go to:

<http://webcam.oregonstate.edu/3dprinter/>



OSU Webcam - Valley Library 3D Printer

Daily Print Log

Date	Time	Print Name
11/19/2024	10:00	Print 1
11/19/2024	10:05	Print 2
11/19/2024	10:10	Print 3
11/19/2024	10:15	Print 4
11/19/2024	10:20	Print 5
11/19/2024	10:25	Print 6
11/19/2024	10:30	Print 7
11/19/2024	10:35	Print 8
11/19/2024	10:40	Print 9
11/19/2024	10:45	Print 10

Print Queue

Print

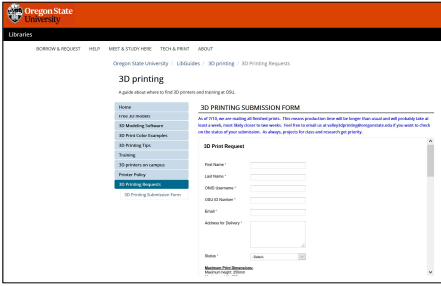
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The OSU Library Has Four 3D Printers for Student Use

To send an STL model to the OSU Library's 3D Printers, go to:

<http://guides.library.oregonstate.edu/3Dprinting/3Dprintform>



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3D printing

3D PRINTING SUBMISSION FORM

Print Name *

User Name *

Email *

Address for Delivery *

Phone *

Submit

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