VIRTUAL REALITY FOR MEMS MATERIAL IN SECOND LIFE USING BLENDER AND SOLIDWORKS

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Abstract - Second Life is a virtual reality that allows 3D models created in CAD software to be imported into a virtual reality. Users can walk, run, fly, talk and teleport as well as see and interact with objects in the virtual world. 3D crystal models for BCC, FCC, HCP unit cells and a model for the SCME MEMS Pressure Sensor have been developed and are viewable in Second Life at the IvyTech Engineering Island. This presentation will describe the workflow used to convert files from Solidworks to Blender to Second Life. Interaction with these objects should enhanced learning opportunities for students.

Software used:

Solidworks is a CAD software package that allows users to draw, dimension and shape an object or assembly and to view it in 2D or 3D. Files can be exported as STL files which can be 3D printed and shared with other users that may use other CAD tools.

Blender is a powerful free graphic tool that will allow the user to import STL files, modify object details, add textures and export as DAE files.

Second Life is a virtual 3D environment where users (avatars) can interface with 3D objects, share virtual experiences like presentations, and build and import 3D objects that users can interact with.

Why bother to do anything virtually?

The 3D virtual space allows users to freely create, share and explore ideas in a graphical way. Some schools have used Second Life as a way to augment the education of students that cannot participate in face-to-face learning. The 3D environment can be:

Virtual is safer and greener but still allows some social interaction between students
Virtual costs significantly less than the physical world
Virtual allows for more exploration, discovery and creation than the physical world
Virtual is truly an immersive experience that is free to the students.

Building and designing with Solidworks

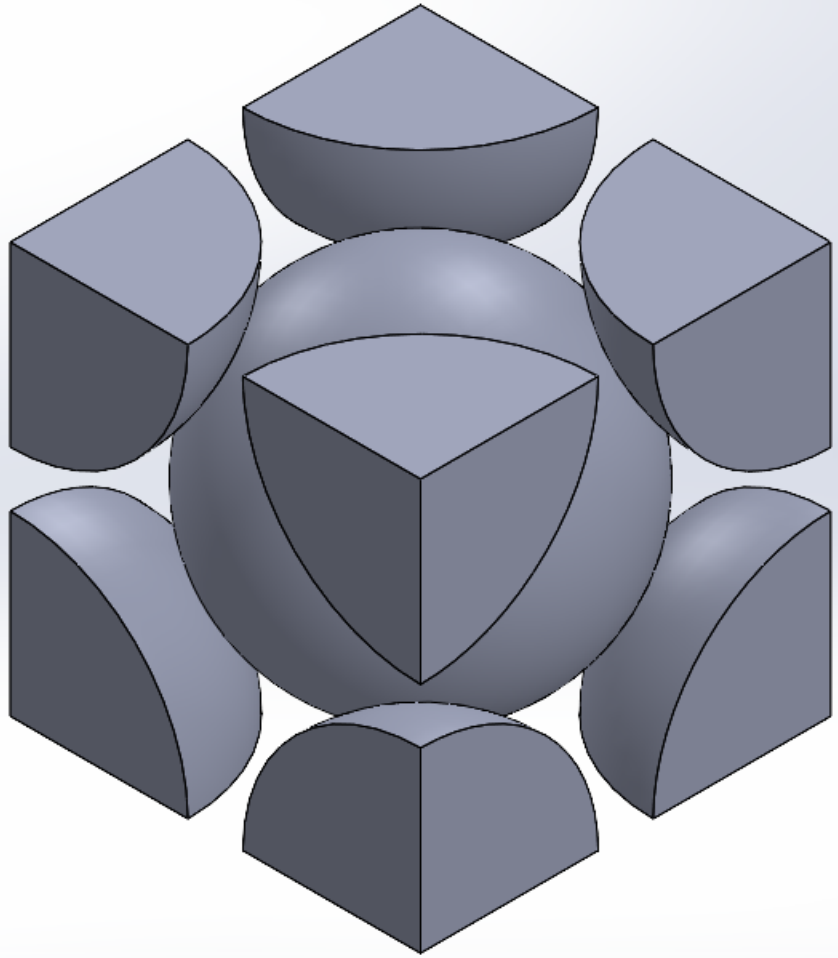
Please refer to the 2019 HI-TEC presentation on “Creating Solidworks Model for SCME Pressure Sensor” for more details. The end goal of using Solidworks is to create a low poly STL file.

Why use Solidworks?

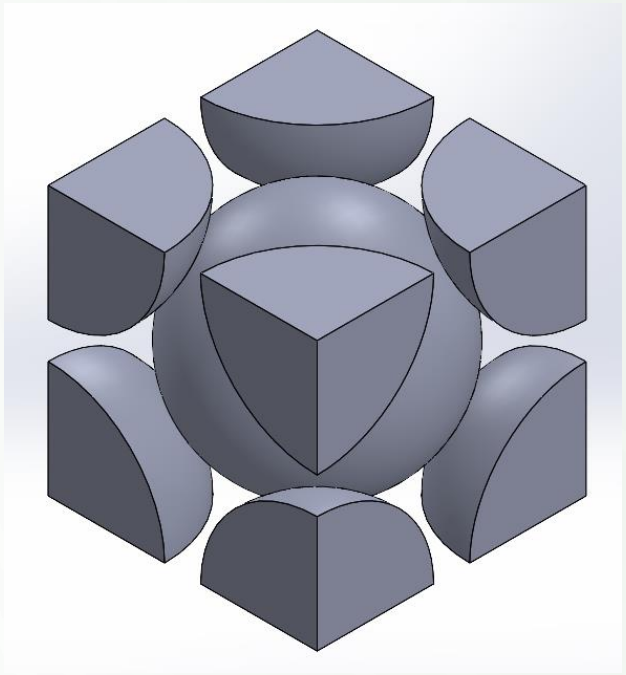
1.) Solidworks allows students to create their own models.
2.) Solidworks is free for the students
3.) Solidworks is a 3D CAD program used in the Engineering Technology and Mechanical Engineering Technology AS programs.
4.) Solidworks can create dimensioned drawings and STL file formats.
5.) Knowledge of Solidworks can help students get a job.

You can download and review the models from https://www.ivytech-mems.org/files/HI-TEC-2021/

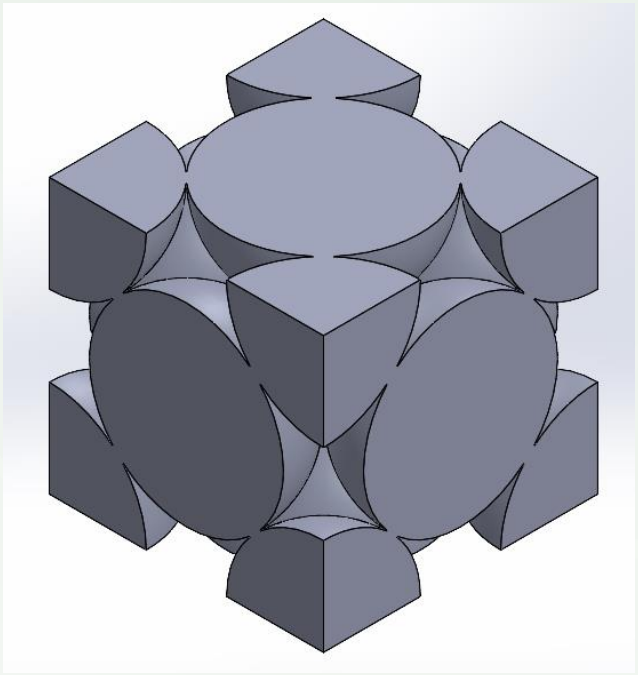
In Solidworks models can be built using various commands. A sketch is created and the extruded or cut to the desired shaped. The creation of the BCC model used numerous commands. The approach was to revolve a pattern around a centerline and create 8 spheres that intercepted a center sphere for the body centered cubic unit cell. Then cut planes were used to trim the outer sphere to the correct shape. The 3D printable also included small extrusions between sphere so that it can be printed.



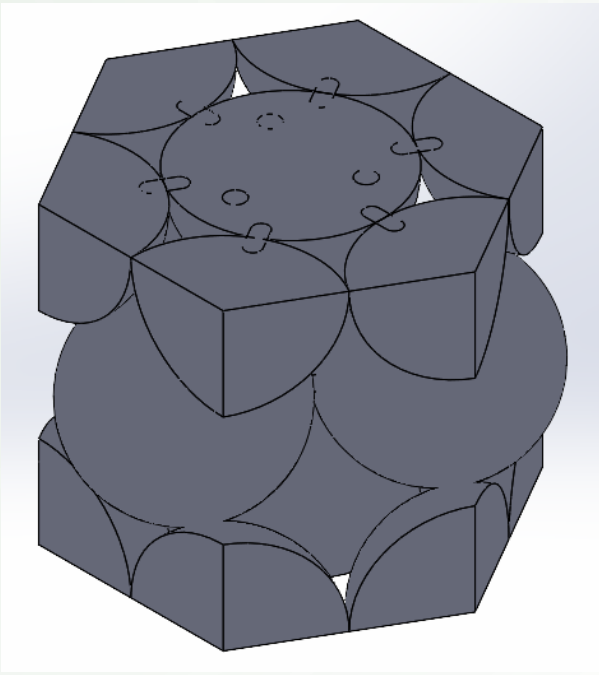
BCC Unit Cell



FCC Unit Cell

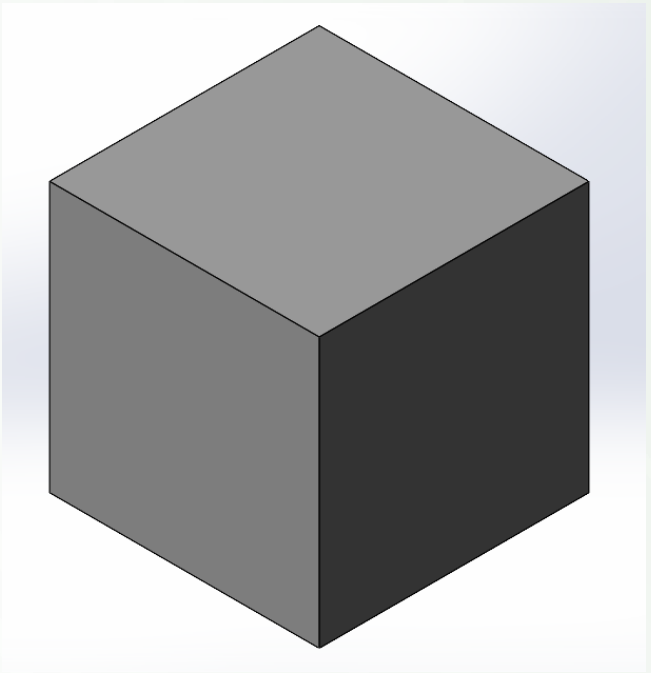


HCP Unit Cell

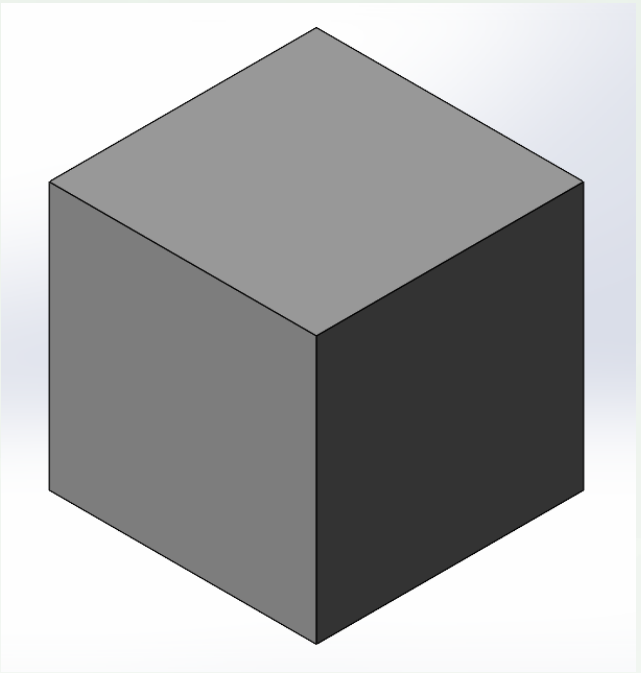


SLDPRT files created in Solidworks with additional support structures added so 3D models could be 3D printed
Models were created to be approximately 1 meter cubes or 1 meter in height.
Saved as STL files, no textures included.

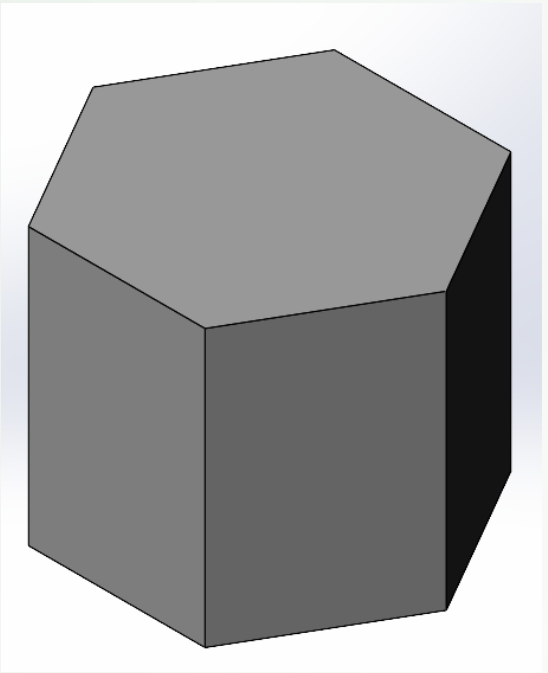
BCC Unit Cell
(physics)



FCC Unit Cell
(physics)



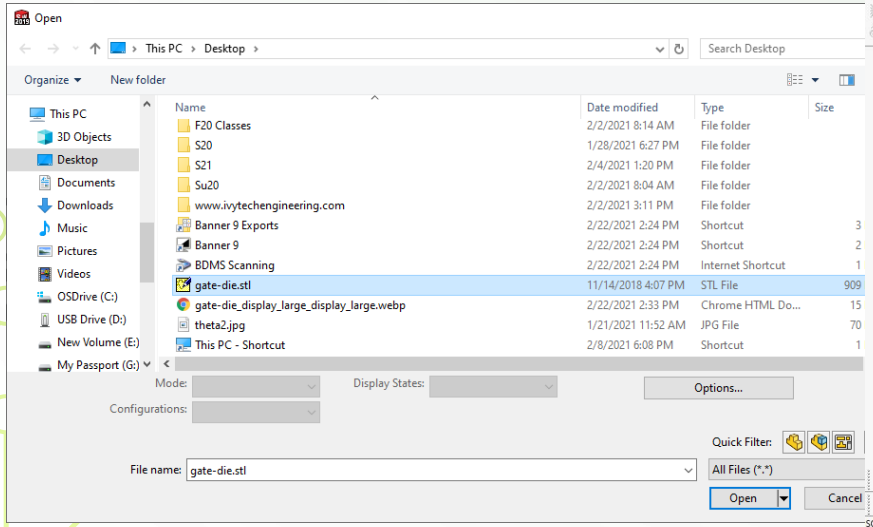
HCP Unit Cell
(physics)

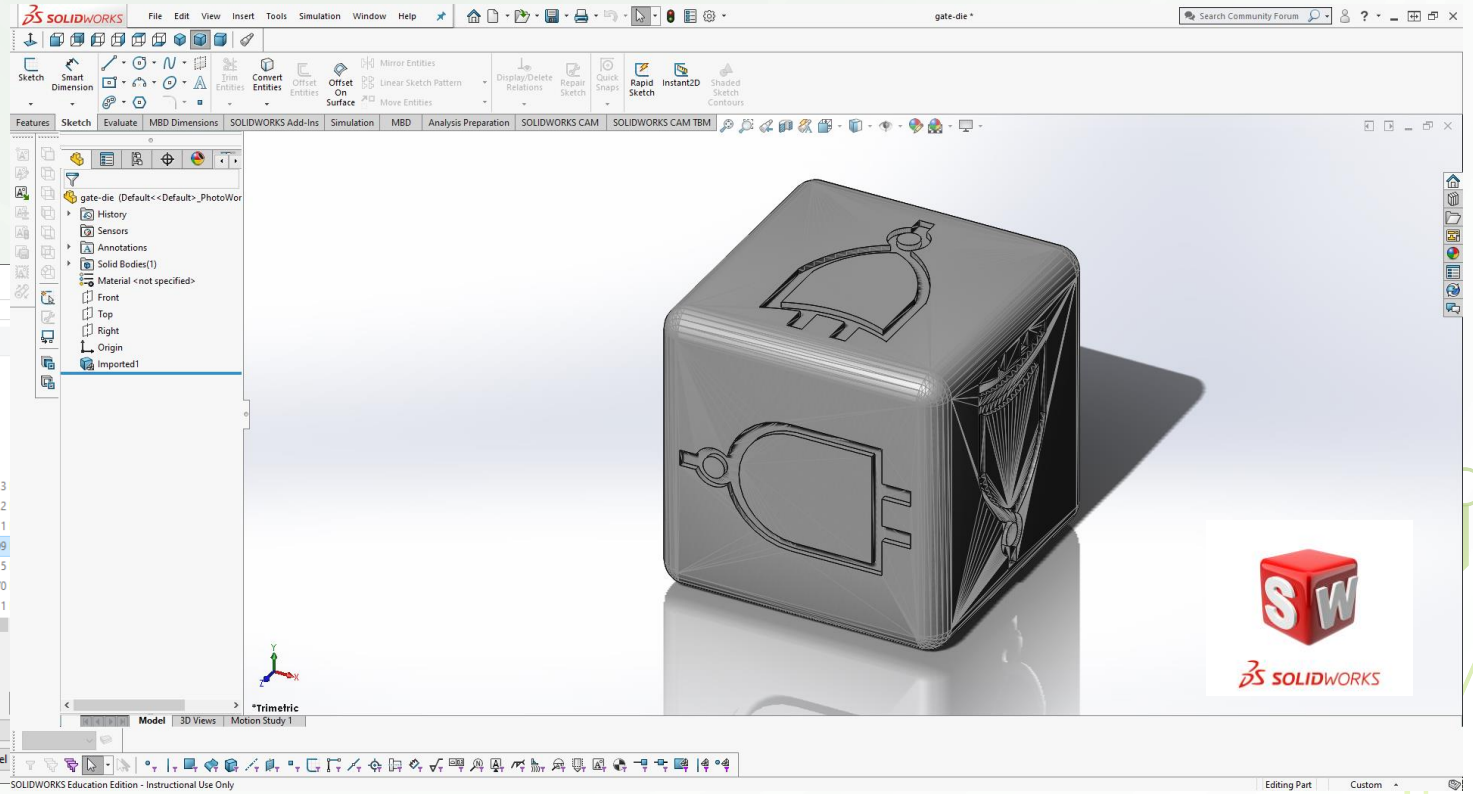


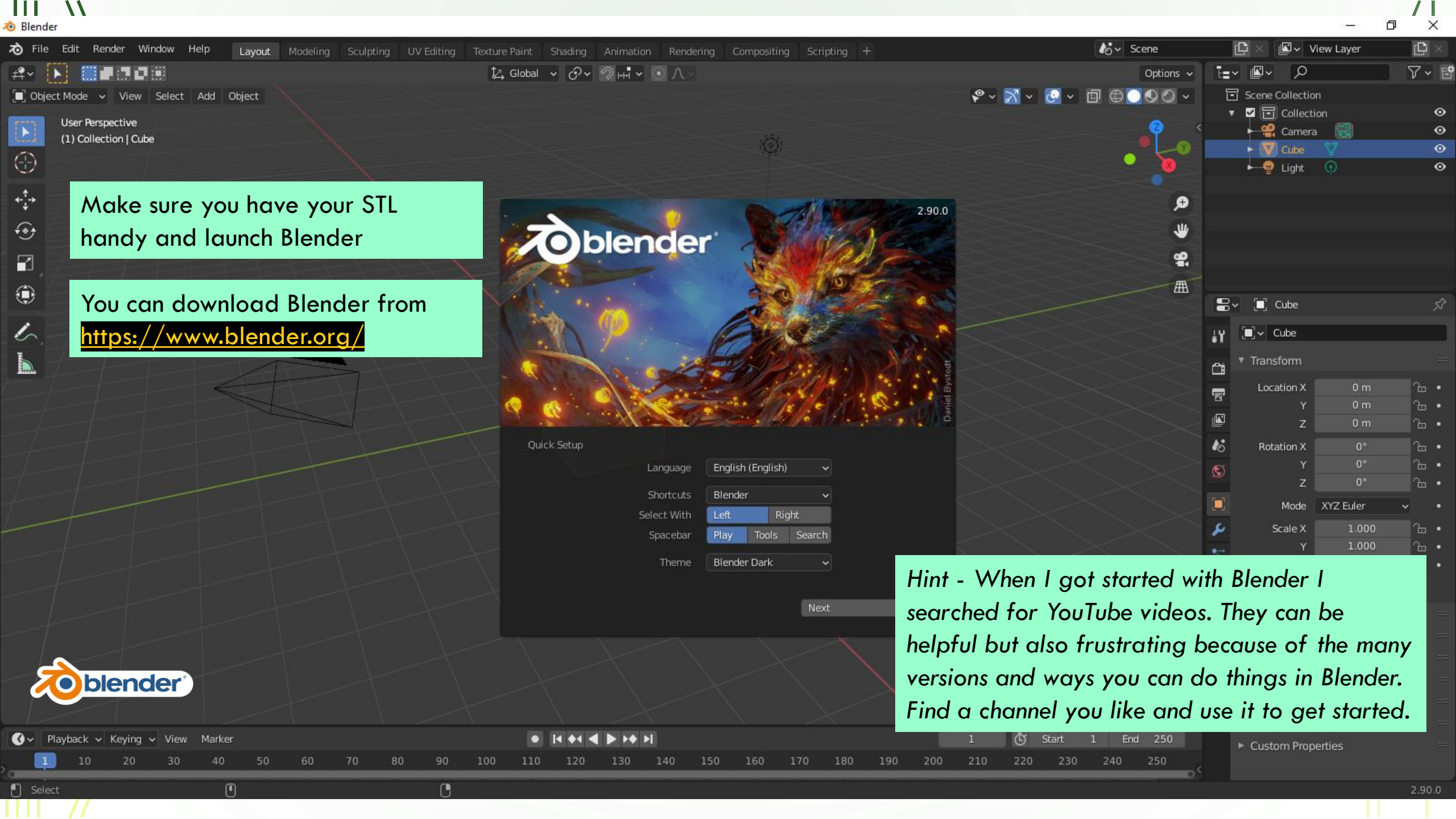
Also, built SLDPRT and STL physics models needed for Second Life (these models are simple boxes)
Physics shapes limit how avatars can interface with objects.

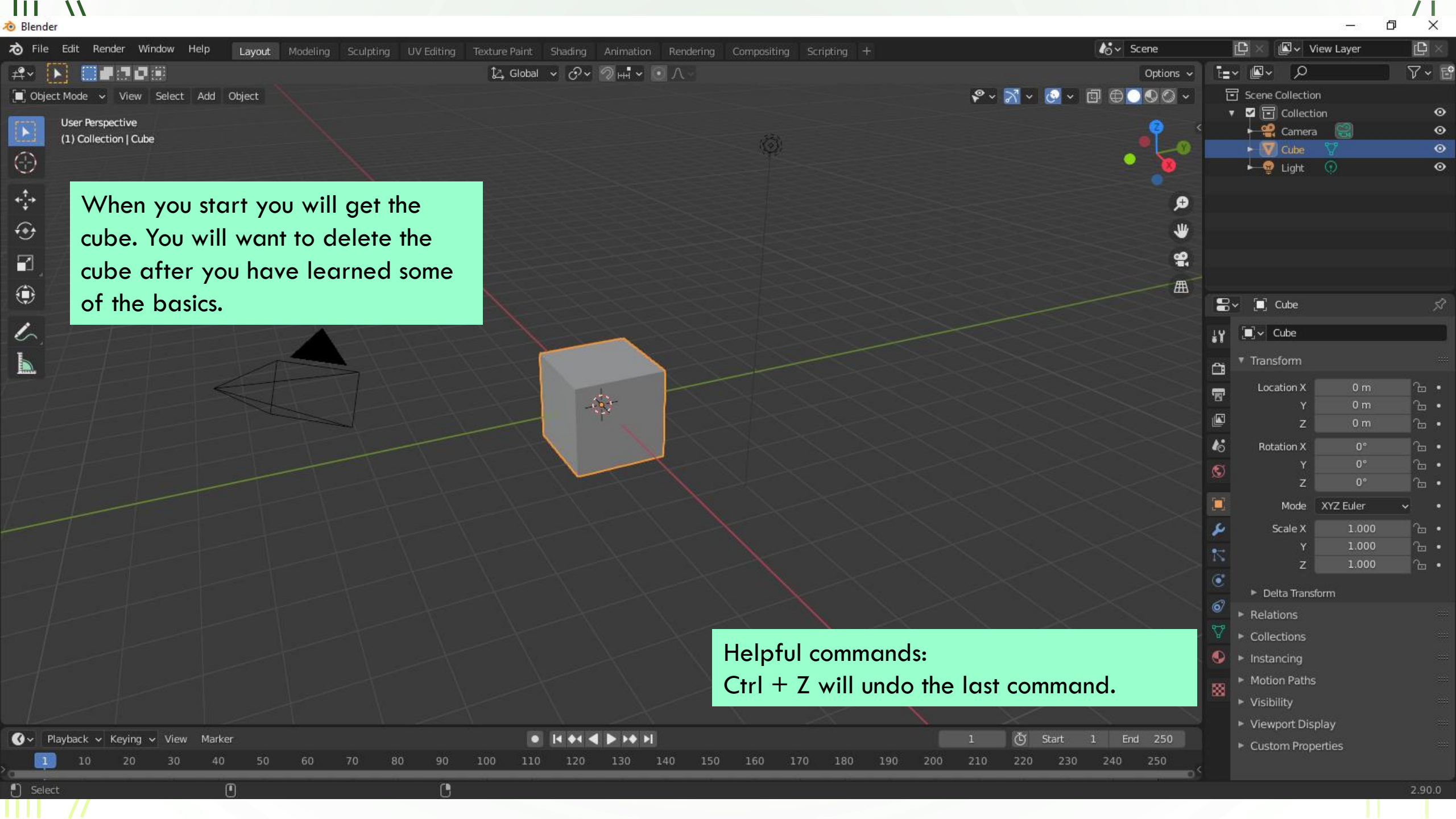
Next, the STL files are imported and modified using Blender. Our objective is to create models that can be used in Second Life from STL models created with programs like Solidworks. STL files need to be converted to DAE files using a program like Blender. As an example, consider the following STL file that was downloaded from the internet https://cults3d.com/en/3d-model/tool/gate-die

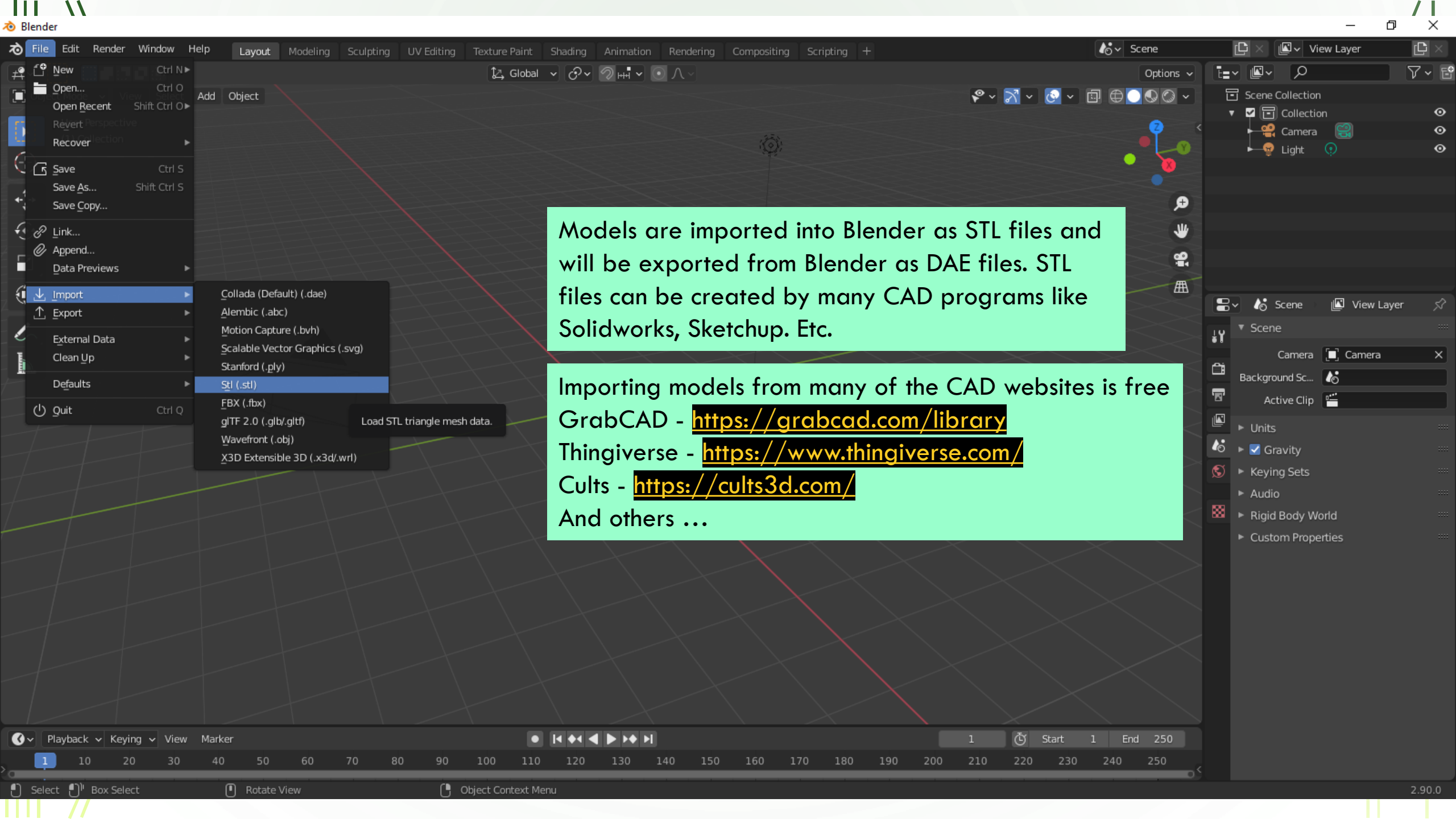
Open model in Solidworks and attempt to convert to SLDPRT file.






Blender
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint Shading Animation Rendering Compositing Scripting
Scene
View Layer
Object Mode View Select Add Object
Global
Options
User Perspective
(1) Collection | Cube
Scene Collection
Collection
Camera
Cube
Light
Make sure you have your STL handy and launch Blender
You can download Blender from https://www.blender.org/
2.90.0
blender
Daniel Bystedt
Quick Setup
Language English (English)
Shortcuts Blender
Select With Left Right
Spacebar Play Tools Search
Theme Blender Dark
Next
Cube
Transform
Location X 0 m
Y 0 m
Z 0 m
Rotation X 0°
Y 0°
Z 0°
Mode XYZ Euler
Scale X 1.000
Y 1.000
Hint - When I got started with Blender I searched for YouTube videos. They can be helpful but also frustrating because of the many versions and ways you can do things in Blender. Find a channel you like and use it to get started.
blender
Playback Keying View Marker
Start 1 End 250
Custom Properties
Select
2.90.0


When you start you will get the cube. You will want to delete the cube after you have learned some of the basics.
Helpful commands:
Ctrl + Z will undo the last command.



Models are imported into Blender as STL files and will be exported from Blender as DAE files. STL files can be created by many CAD programs like Solidworks, Sketchup. Etc.

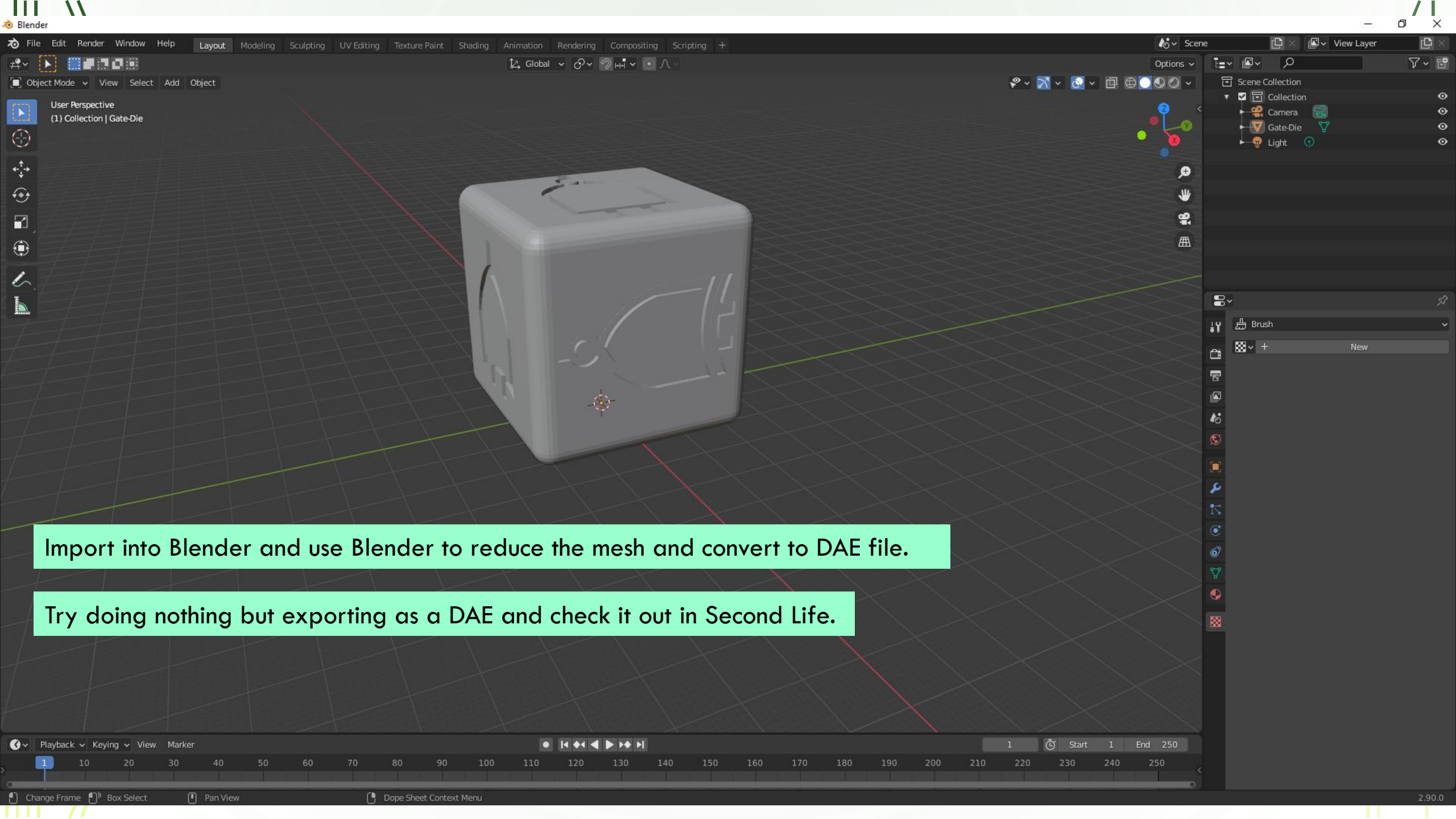
Importing models from many of the CAD websites is free

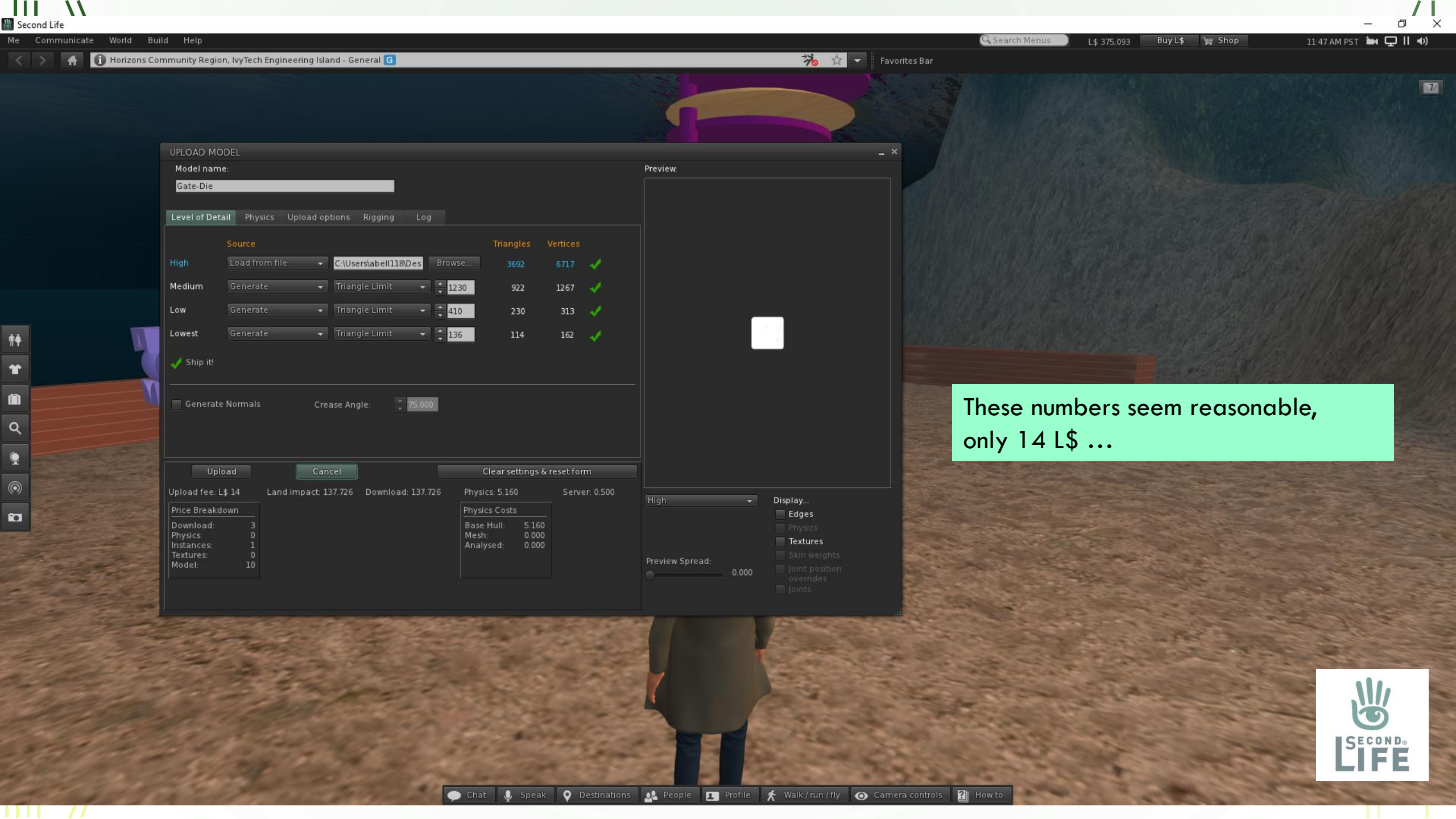
GrabCAD - https://grabcad.com/library

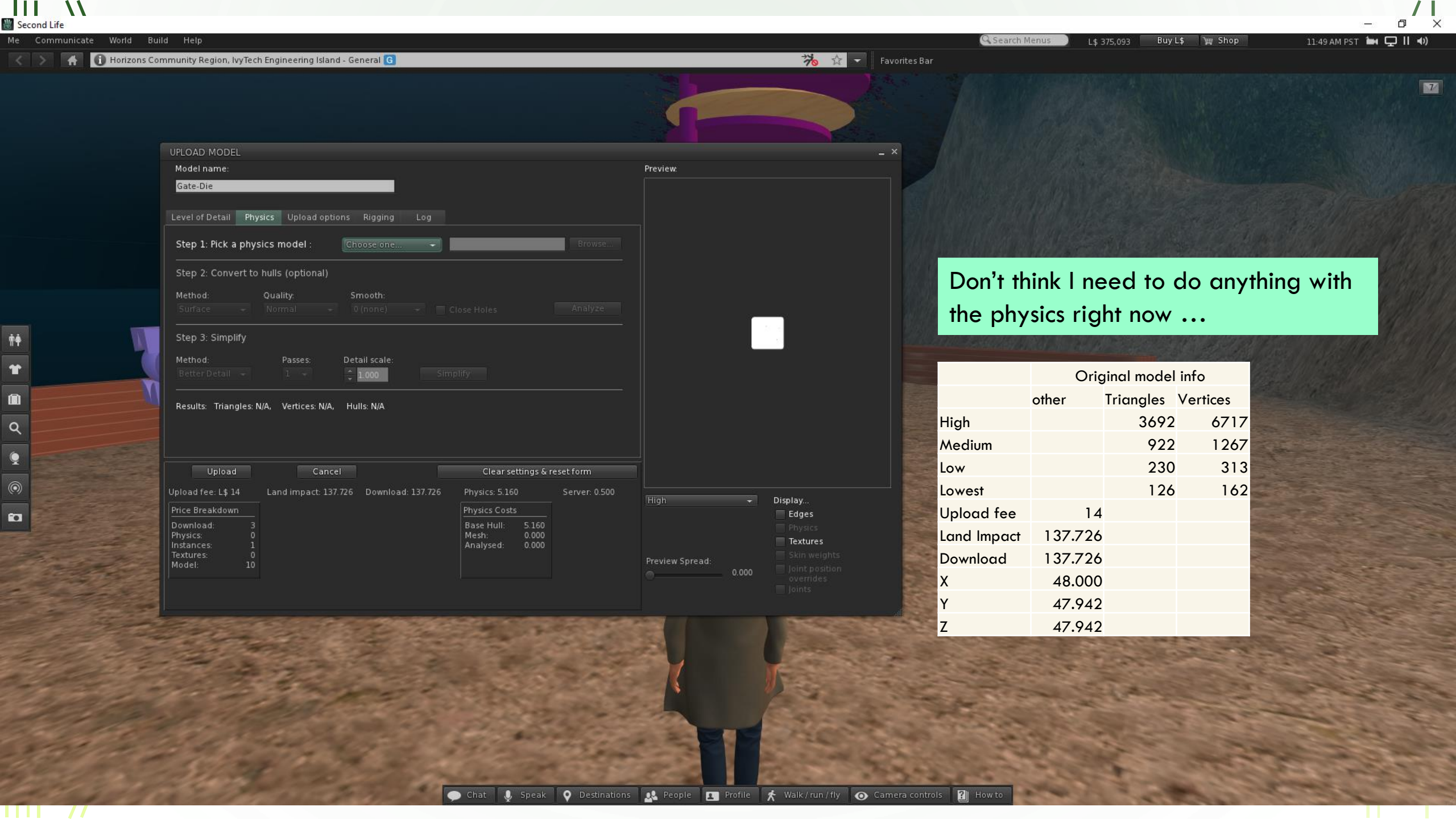
Thingiverse - https://www.thingiverse.com/

Cults - https://cults3d.com/

And others …

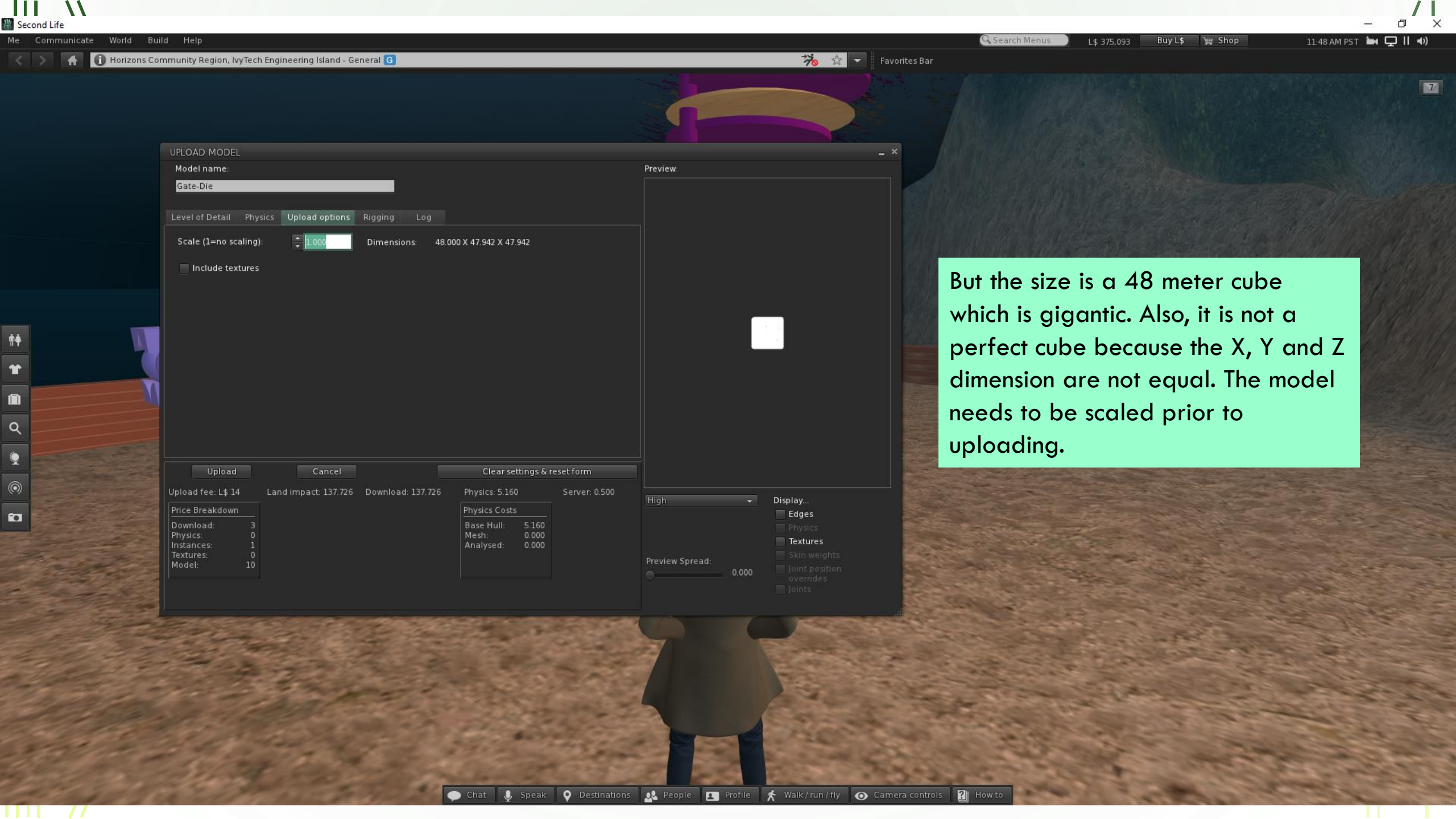

Blender
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint Shading Animation Rendering Compositing Scripting
Scene
View Layer
Object Mode View Select Add Object
Global
Options
User Perspective
(1) Collection | Gate-Die
Scene Collection
Collection
Camera
Gate-Die
Light
Brush
New
Import into Blender and use Blender to reduce the mesh and convert to DAE file.
Try doing nothing but exporting as a DAE and check it out in Second Life.
Playback Keying View Marker
Start 1 End 250
Change Frame Box Select Pan View Dope Sheet Context Menu
2.90.0


Second Life
Me
Communicate
World
Build
Help
Search Menus
L$ 375,093
Buy L$
Shop
11:47 AM PST
Horizons Community Region, IvyTech Engineering Island - General
Favorites Bar
UPLOAD MODEL
Model name:
Gate-Die
Preview:
Level of Detail
Physics
Upload options
Rigging
Log
Source
Triangles
Vertices
High
Load from file
C:\Users\abell118\Des
Browse...
3692
6717
Medium
Generate
Triangle Limit
1230
922
1267
Low
Generate
Triangle Limit
410
230
313
Lowest
Generate
Triangle Limit
136
114
162
Ship it!
Generate Normals
Crease Angle:
75.000
Upload
Cancel
Clear settings & reset form
Upload fee: L$ 14
Land impact: 137.726
Download: 137.726
Physics: 5.160
Server: 0.500
Price Breakdown
Download: 3
Physics: 0
Instances: 1
Textures: 0
Model: 10
Physics Costs
Base Hull: 5.160
Mesh: 0.000
Analysed: 0.000
High
Display...
Edges
Physics
Textures
Skin weights
Joint position overrides
Joints
Preview Spread:
0.000
Chat
Speak
Destinations
People
Profile
Walk / run / fly
Camera controls
How to
These numbers seem reasonable, only 14 L$ …

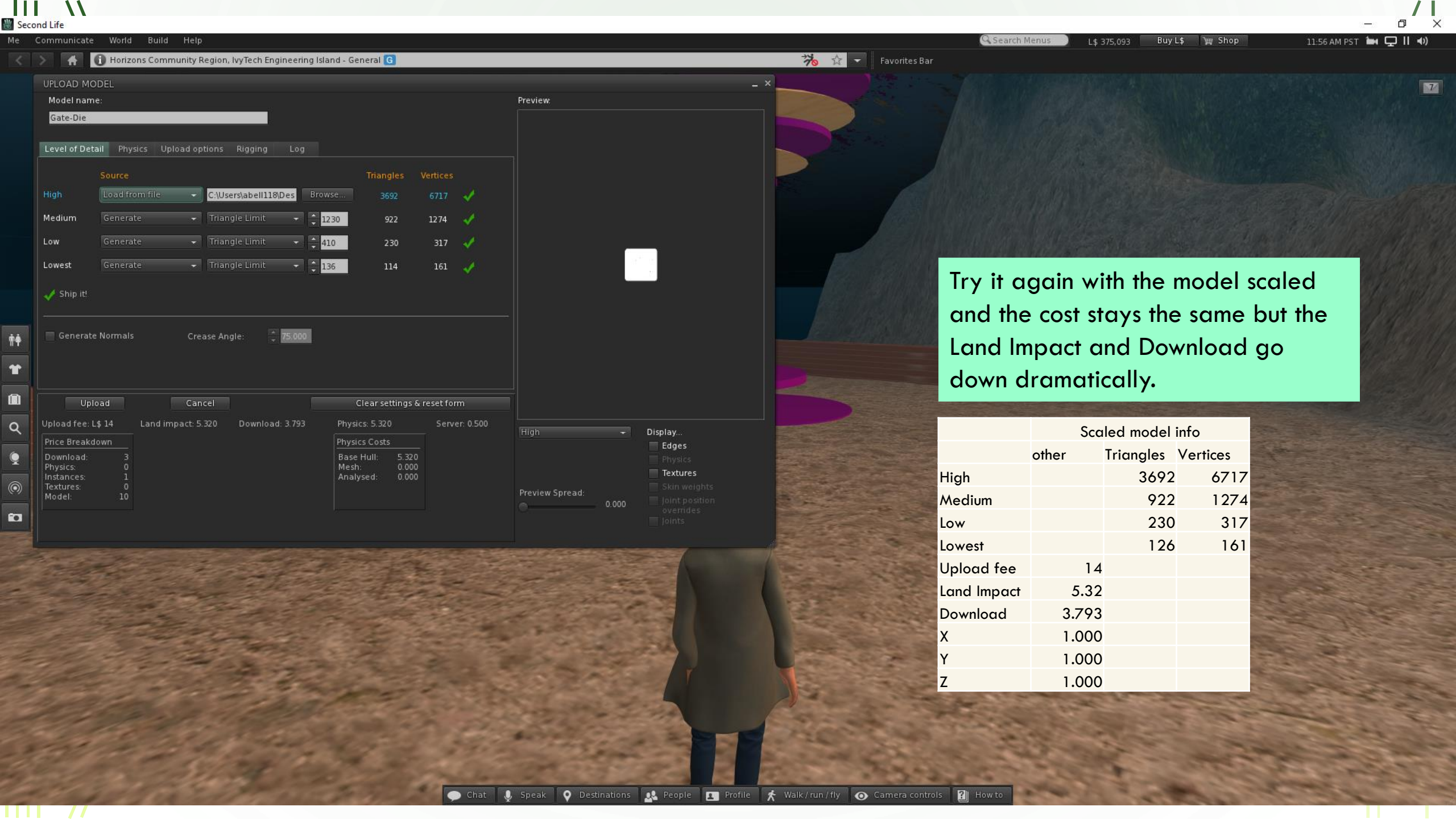


Don't think I need to do anything with the physics right now …

	Original model info		
	other	Triangles	Vertices
High		3692	6717
Medium		922	1267
Low		230	313
Lowest		126	162
Upload fee	14		
Land Impact	137.726		
Download	137.726		
X	48.000		
Y	47.942		
Z	47.942		

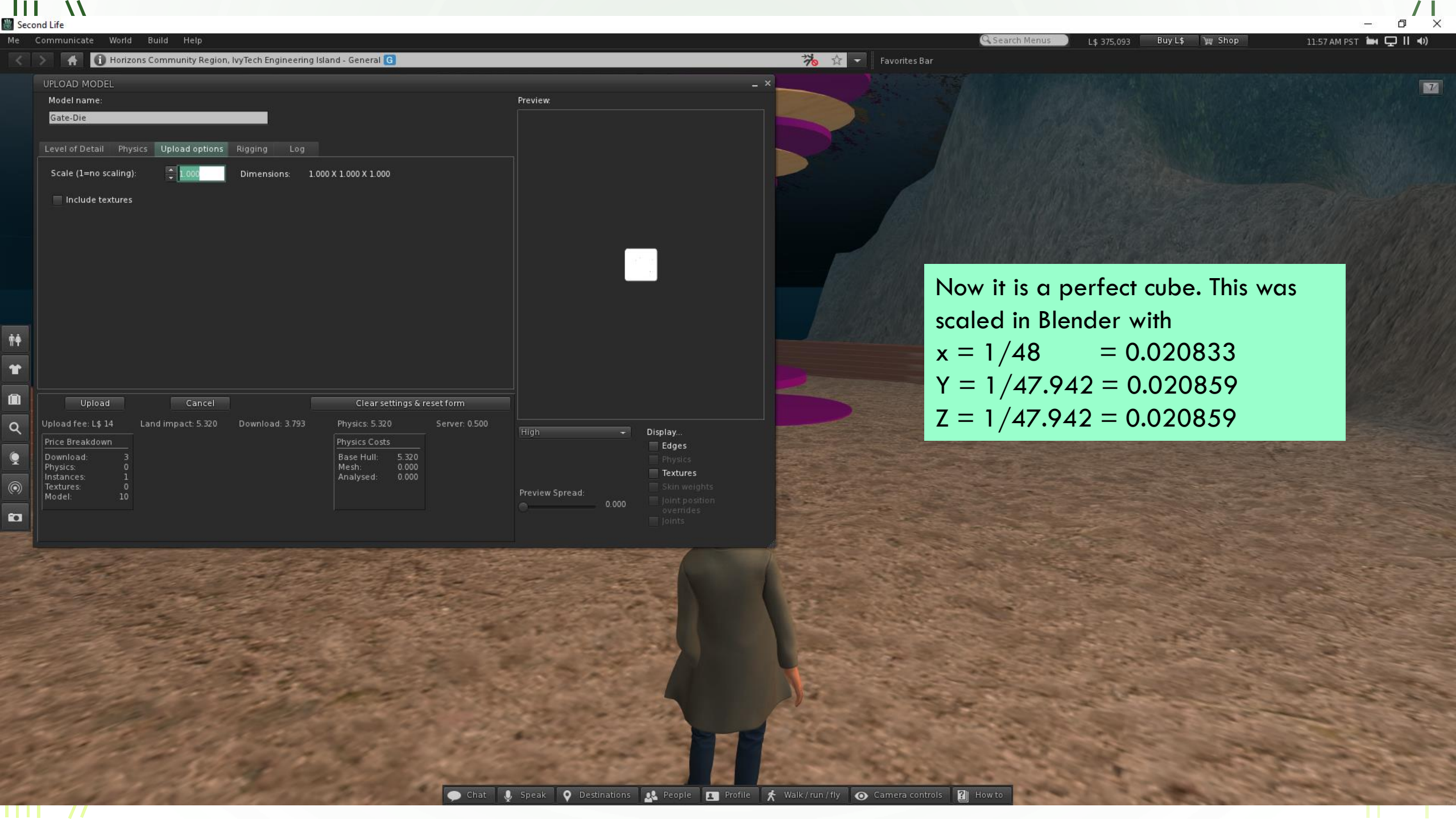


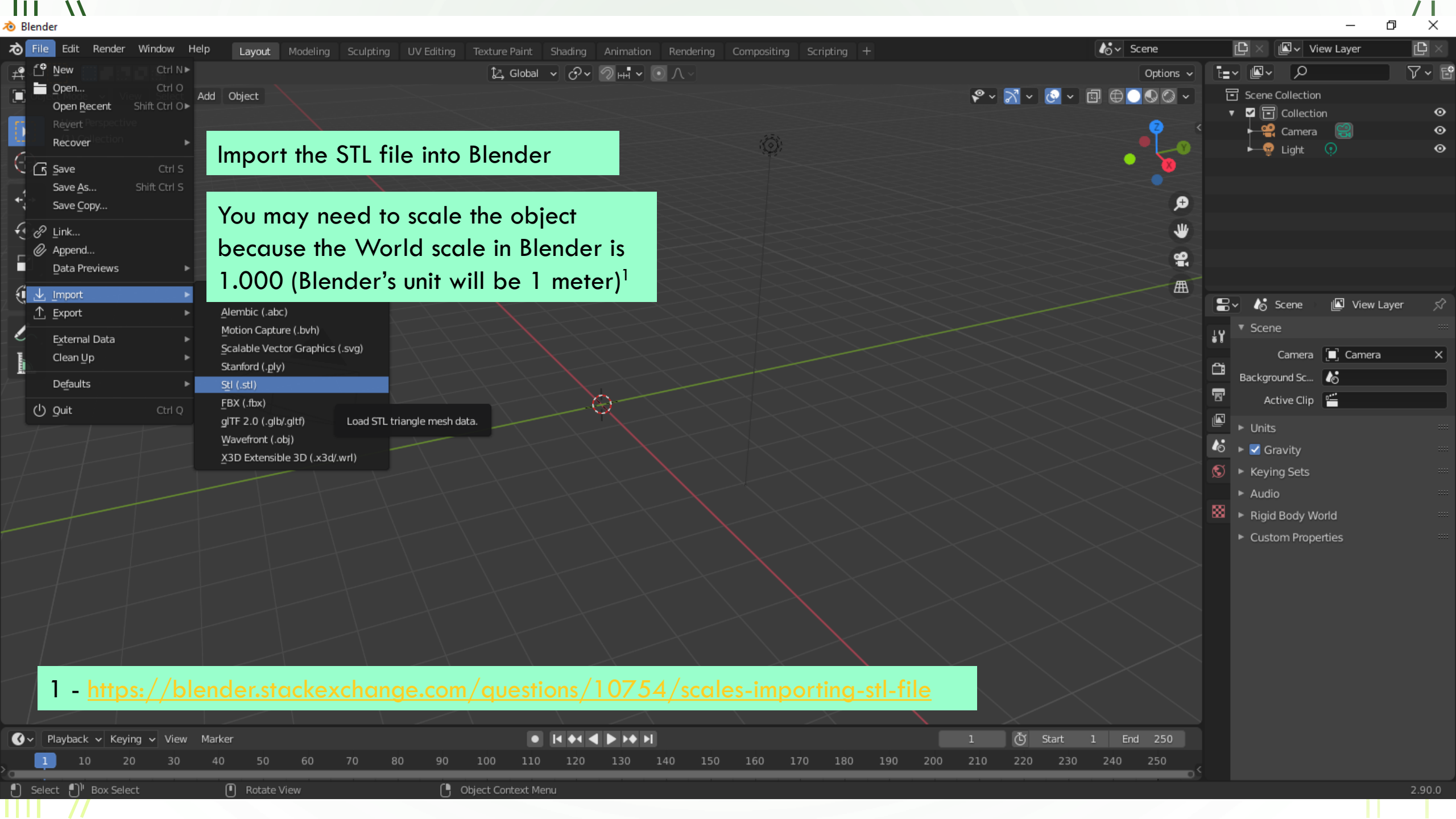
But the size is a 48 meter cube which is gigantic. Also, it is not a perfect cube because the X, Y and Z dimension are not equal. The model needs to be scaled prior to uploading.

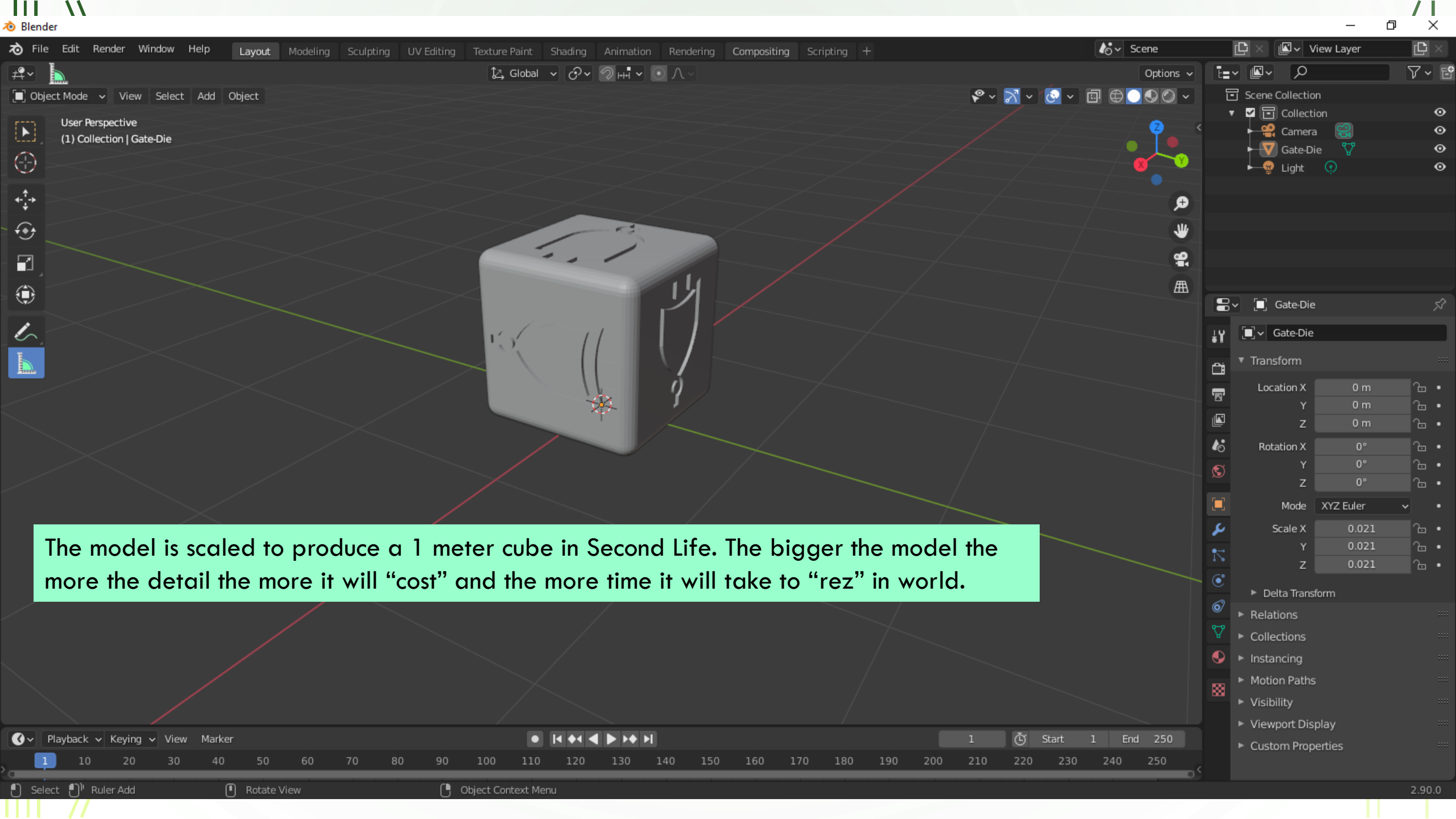


Try it again with the model scaled and the cost stays the same but the Land Impact and Download go down dramatically.

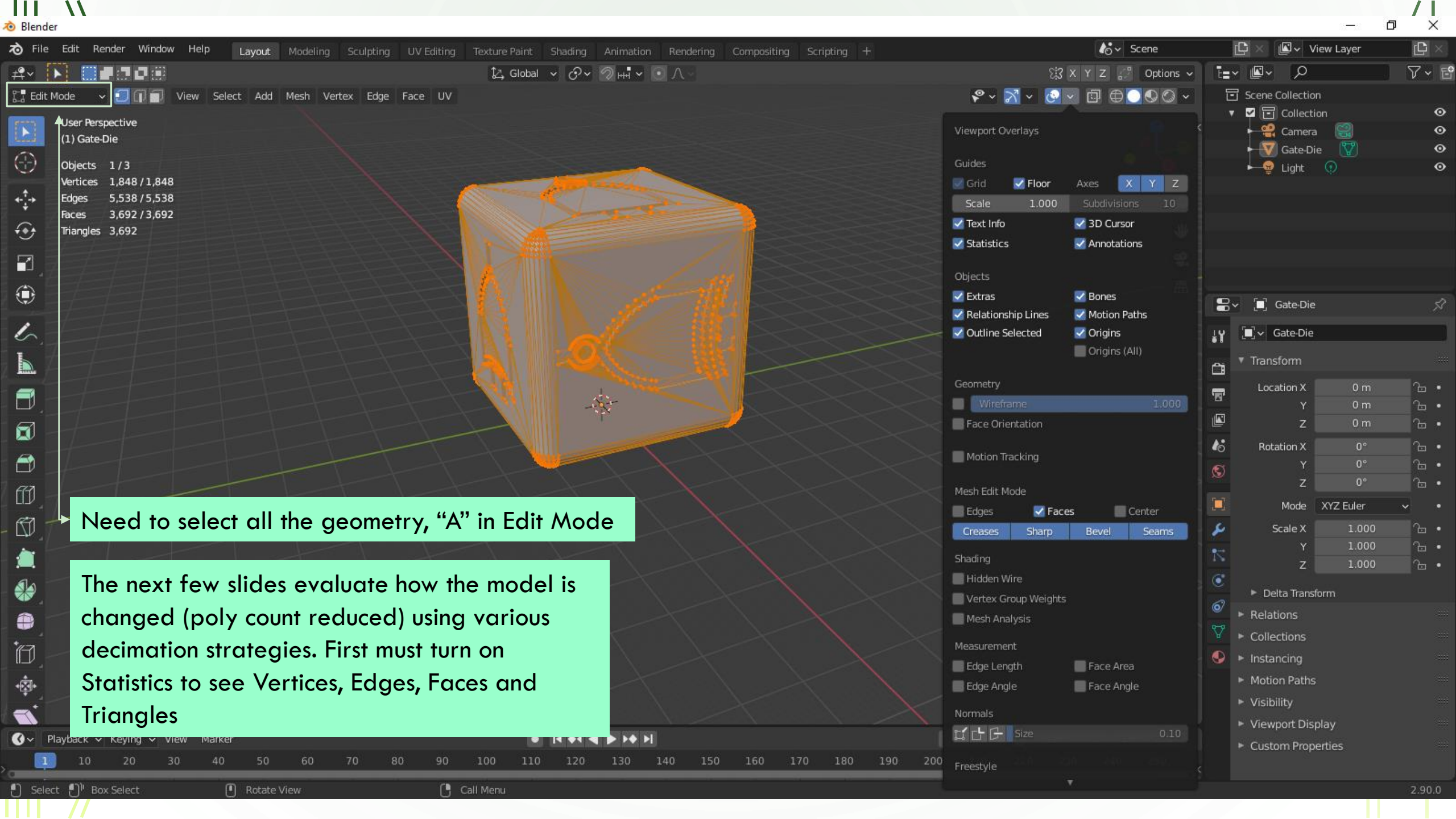
	Scaled model info		
	other	Triangles	Vertices
High		3692	6717
Medium		922	1274
Low		230	317
Lowest		126	161
Upload fee	14		
Land Impact	5.32		
Download	3.793		
X	1.000		
Y	1.000		
Z	1.000		

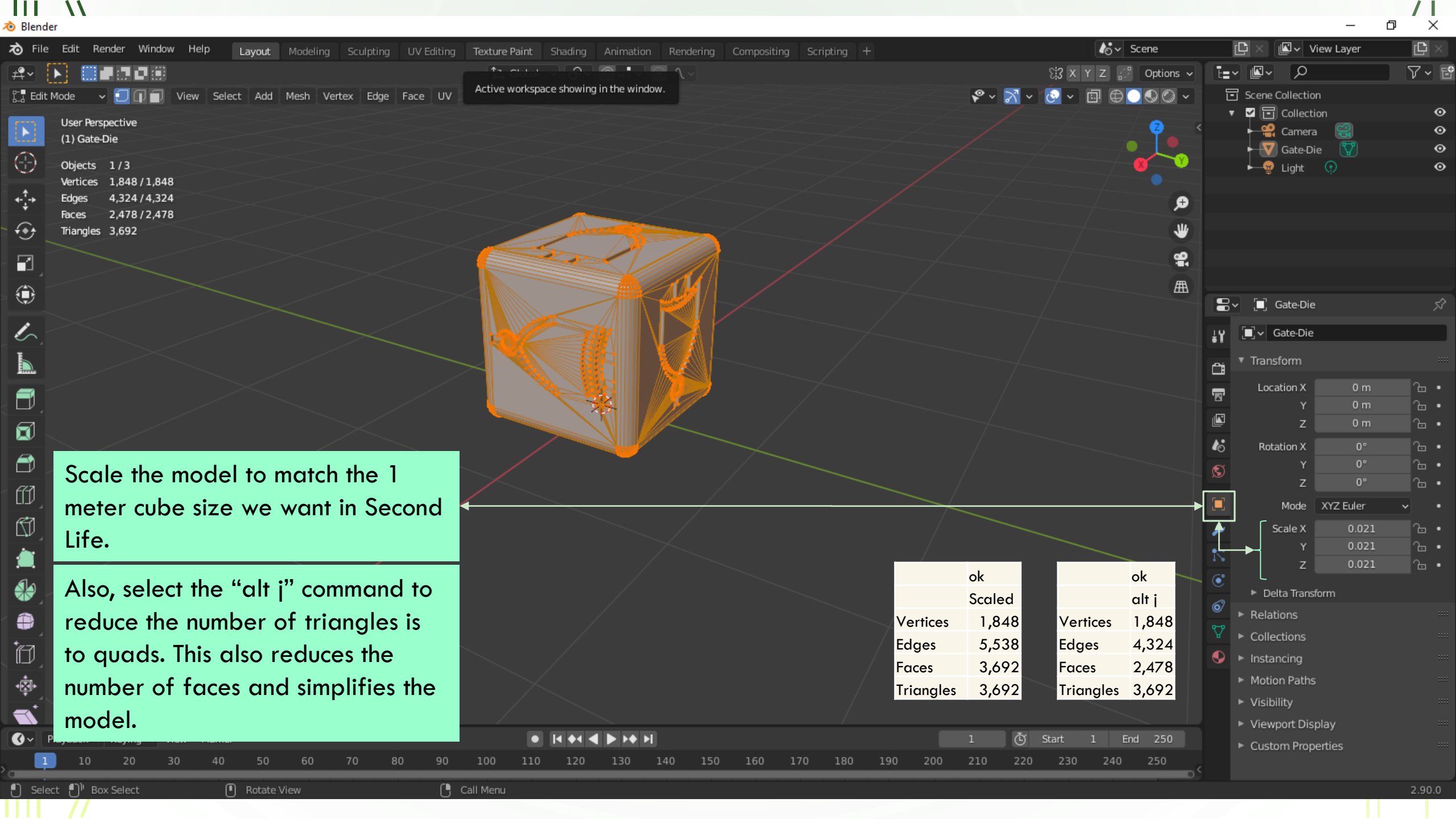

Second Life
Me Communicate World Build Help
Search Menus
L$ 375,093
Buy L$
Shop
11:57 AM PST
Horizons Community Region, IvyTech Engineering Island - General
Favorites Bar
UPLOAD MODEL
Model name:
Gate-Die
Preview:
Level of Detail
Physics
Upload options
Rigging
Log
Scale (1=no scaling):
1.000
Dimensions:
1.000 X 1.000 X 1.000
Include textures
Upload
Cancel
Clear settings & reset form
Upload fee: L$ 14
Land impact: 5.320
Download: 3.793
Physics: 5.320
Server: 0.500
Price Breakdown
Download: 3
Physics: 0
Instances: 1
Textures: 0
Model: 10
Physics Costs
Base Hull: 5.320
Mesh: 0.000
Analysed: 0.000
High
Display...
Edges
Physics
Textures
Skin weights
Joint position overrides
Joints
Preview Spread:
0.000
Chat
Speak
Destinations
People
Profile
Walk / run / fly
Camera controls
How to
Now it is a perfect cube. This was scaled in Blender with
x = 1/48 = 0.020833
Y = 1/47.942 = 0.020859
Z = 1/47.942 = 0.020859


Blender
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint Shading Animation Rendering Compositing Scripting
Scene
View Layer
New Ctrl N
Open... Ctrl O
Open Recent Shift Ctrl O
Revert
Recover
Save Ctrl S
Save As... Shift Ctrl S
Save Copy...
Link...
Append...
Data Previews
Import
Export
External Data
Clean Up
Defaults
Quit Ctrl Q
Alembic (.abc)
Motion Capture (.bvh)
Scalable Vector Graphics (.svg)
Stanford (.ply)
Stl (.stl)
FBX (.fbx)
glTF 2.0 (.glb/.gltf)
Wavefront (.obj)
X3D Extensible 3D (.x3d/.wrl)
Load STL triangle mesh data.
Import the STL file into Blender
You may need to scale the object because the World scale in Blender is 1.000 (Blender's unit will be 1 meter)[1]
Scene Collection
Collection
Camera
Light
Camera
Background Sc...
Active Clip
Units
Gravity
Keying Sets
Audio
Rigid Body World
Custom Properties
Playback Keying View Marker
Start 1 End 250
Select Box Select Rotate View Object Context Menu
2.90.0
1 - https://blender.stackexchange.com/questions/10754/scales-importing-stl-file



The model is scaled to produce a 1 meter cube in Second Life. The bigger the model the more the detail the more it will "cost" and the more time it will take to "rez" in world.


Blender
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint Shading Animation Rendering Compositing Scripting
Scene
View Layer
Edit Mode
View Select Add Mesh Vertex Edge Face UV
Global
Options
User Perspective
(1) Gate-Die
Objects 1 / 3
Vertices 1,848 / 1,848
Edges 5,538 / 5,538
Faces 3,692 / 3,692
Triangles 3,692
Viewport Overlays
Guides
Grid
Floor
Axes
X Y Z
Scale 1.000
Subdivisions 10
Text Info
3D Cursor
Statistics
Annotations
Objects
Extras
Bones
Relationship Lines
Motion Paths
Outline Selected
Origins
Origins (All)
Geometry
Wireframe 1.000
Face Orientation
Motion Tracking
Mesh Edit Mode
Edges
Faces
Center
Creases
Sharp
Bevel
Seams
Shading
Hidden Wire
Vertex Group Weights
Mesh Analysis
Measurement
Edge Length
Face Area
Edge Angle
Face Angle
Normals
Size 0.10
Freestyle
Scene Collection
Collection
Camera
Gate-Die
Light
Gate-Die
Transform
Location X 0 m
Y 0 m
Z 0 m
Rotation X 0°
Y 0°
Z 0°
Mode XYZ Euler
Scale X 1.000
Y 1.000
Z 1.000
Delta Transform
Relations
Collections
Instancing
Motion Paths
Visibility
Viewport Display
Custom Properties
Need to select all the geometry, “A” in Edit Mode
The next few slides evaluate how the model is changed (poly count reduced) using various decimation strategies. First must turn on Statistics to see Vertices, Edges, Faces and Triangles
Playback Keying View Marker
1 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
Select Box Select Rotate View Call Menu
2.90.0

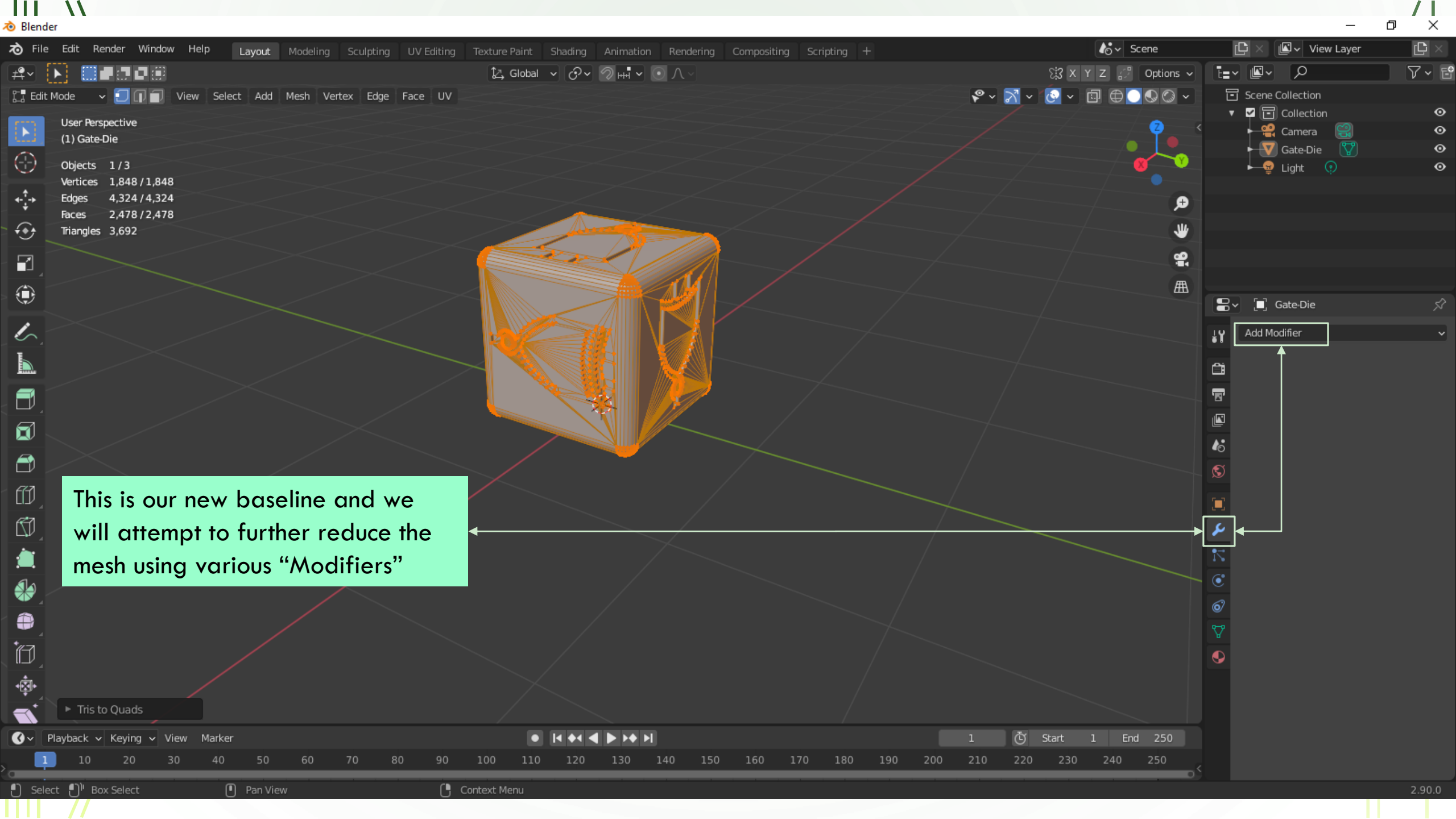


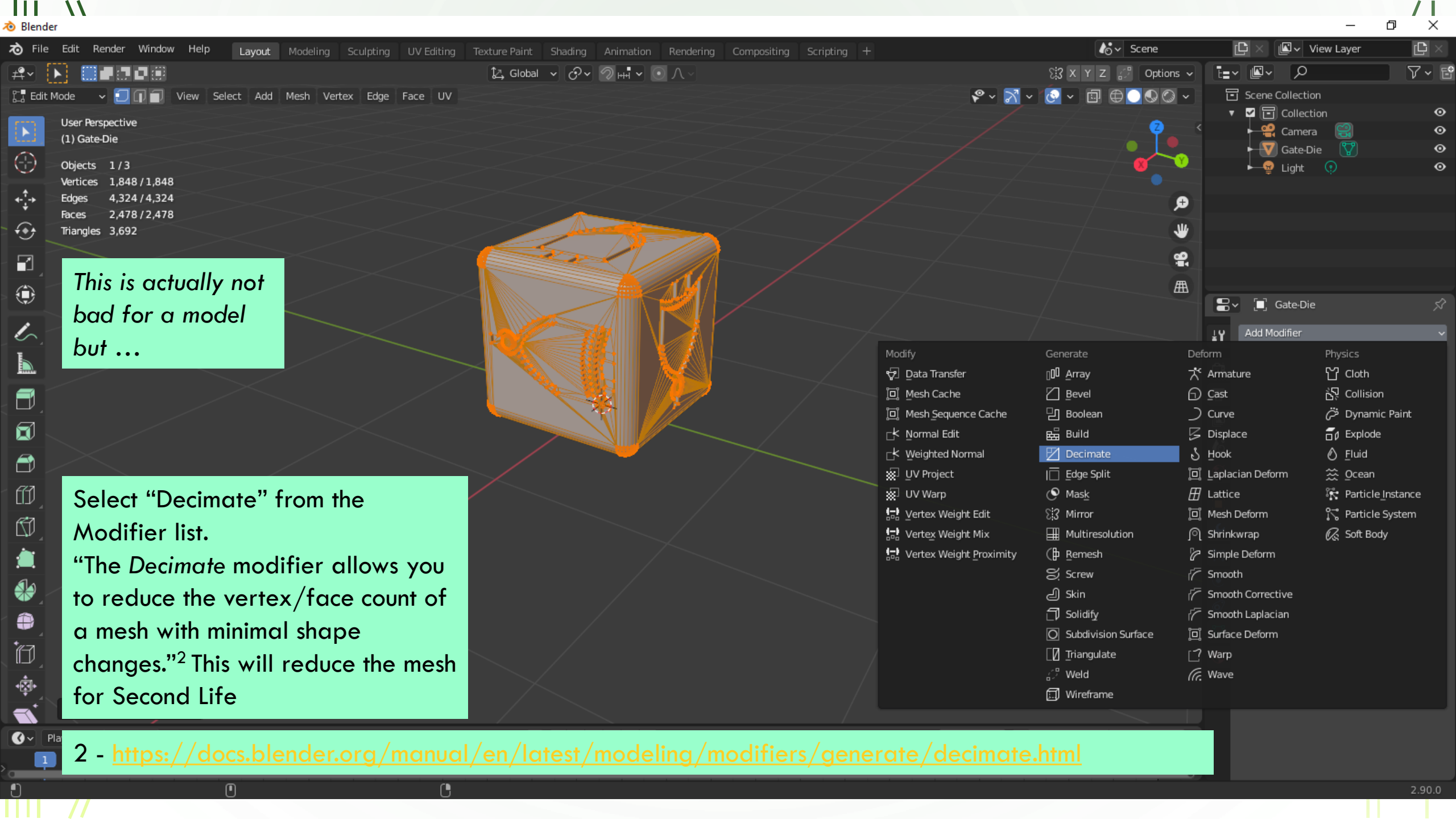
Scale the model to match the 1 meter cube size we want in Second Life.

Also, select the “alt j” command to reduce the number of triangles is to quads. This also reduces the number of faces and simplifies the model.

	ok Scaled
Vertices	1,848
Edges	5,538
Faces	3,692
Triangles	3,692

	ok alt j
Vertices	1,848
Edges	4,324
Faces	2,478
Triangles	3,692

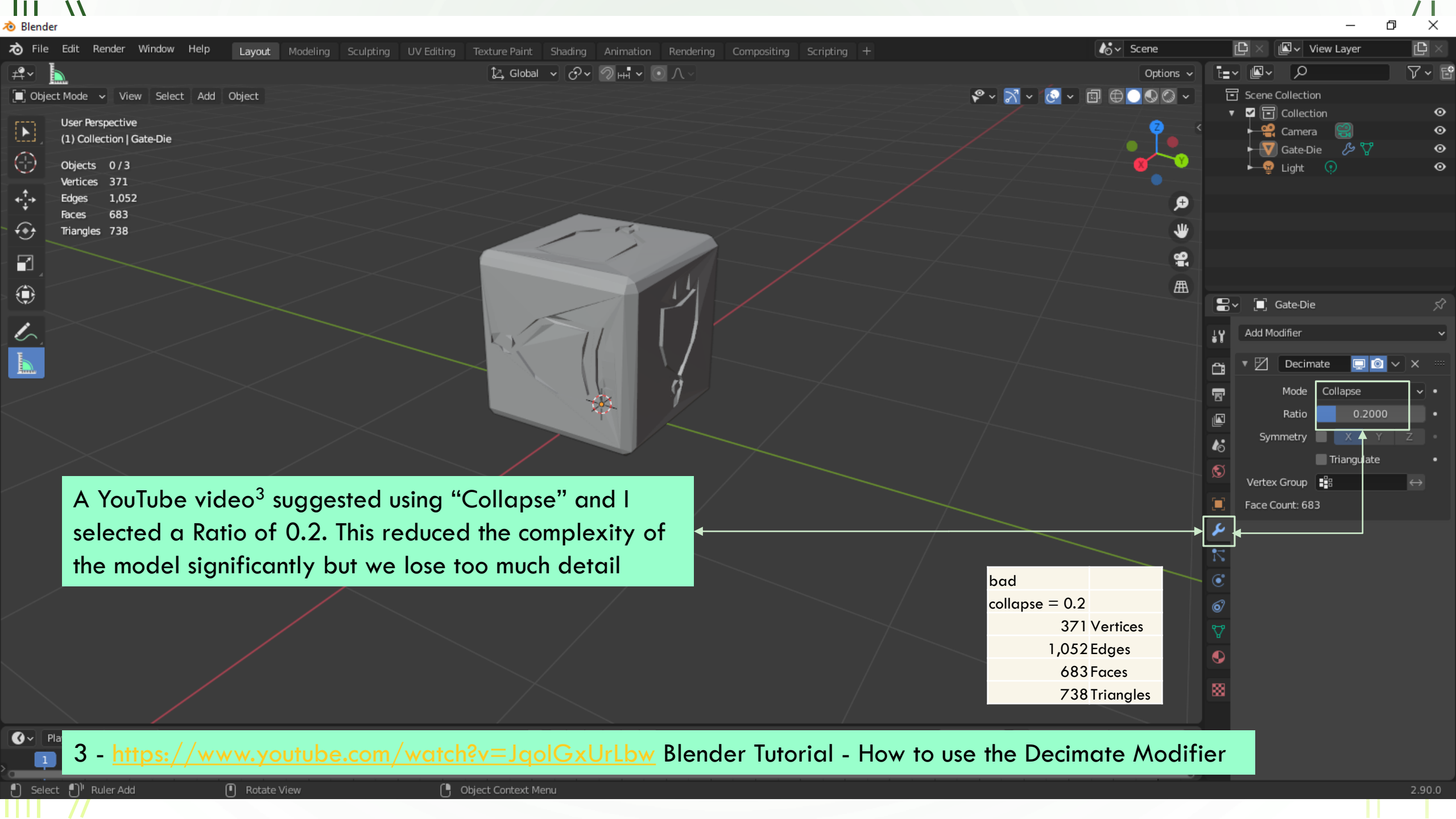

Blender
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint Shading Animation Rendering Compositing Scripting
Scene
View Layer
Edit Mode
View Select Add Mesh Vertex Edge Face UV
Global
Options
User Perspective
(1) Gate-Die
Objects 1 / 3
Vertices 1,848 / 1,848
Edges 4,324 / 4,324
Faces 2,478 / 2,478
Triangles 3,692
Scene Collection
Collection
Camera
Gate-Die
Light
Gate-Die
Add Modifier
This is our new baseline and we will attempt to further reduce the mesh using various “Modifiers”
Tris to Quads
Playback Keying View Marker
Start 1 End 250
Select Box Select Pan View Context Menu
2.90.0

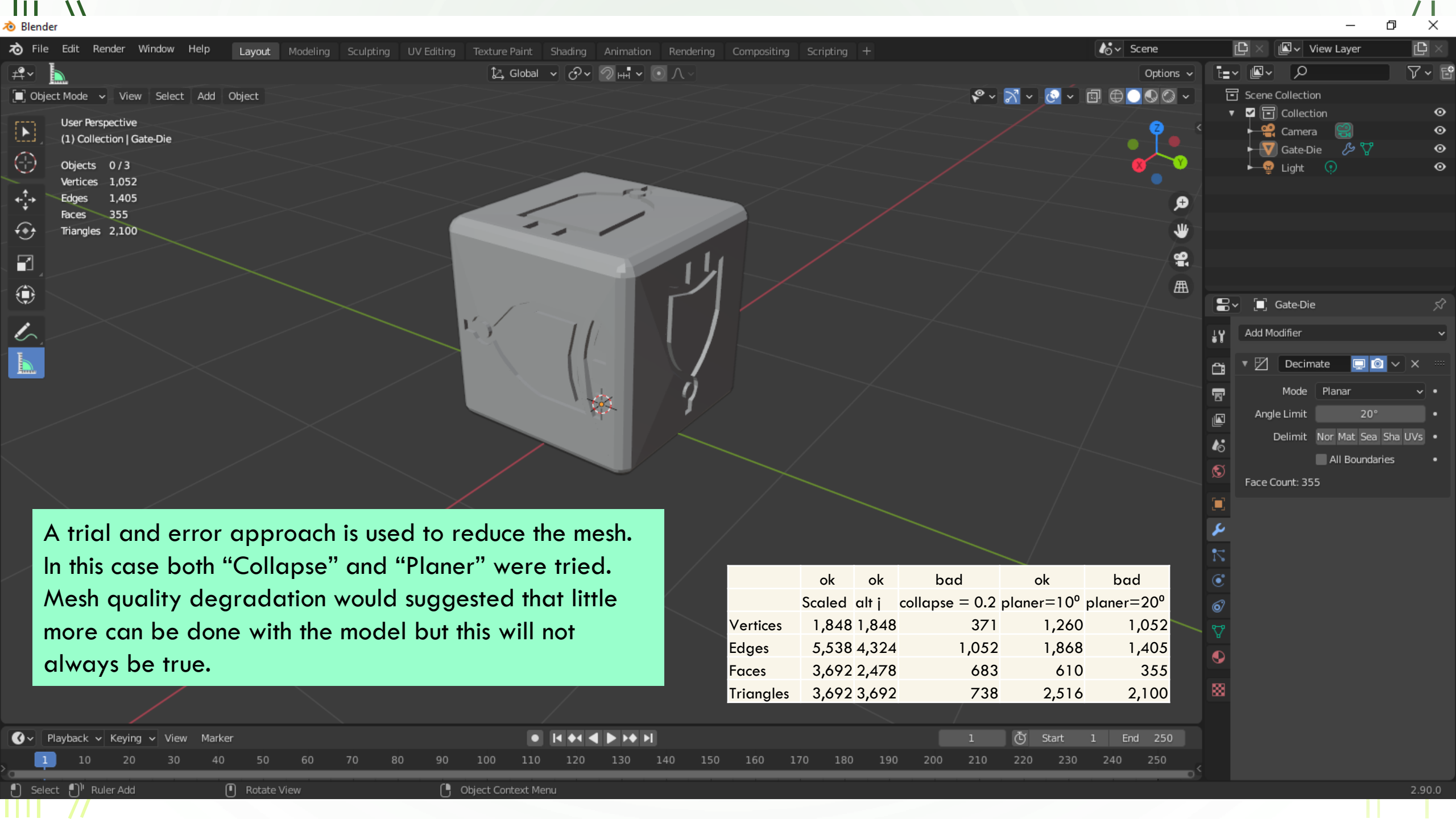


This is actually not bad for a model but …

Select “Decimate” from the Modifier list.
“The *Decimate* modifier allows you to reduce the vertex/face count of a mesh with minimal shape changes.”[2] This will reduce the mesh for Second Life

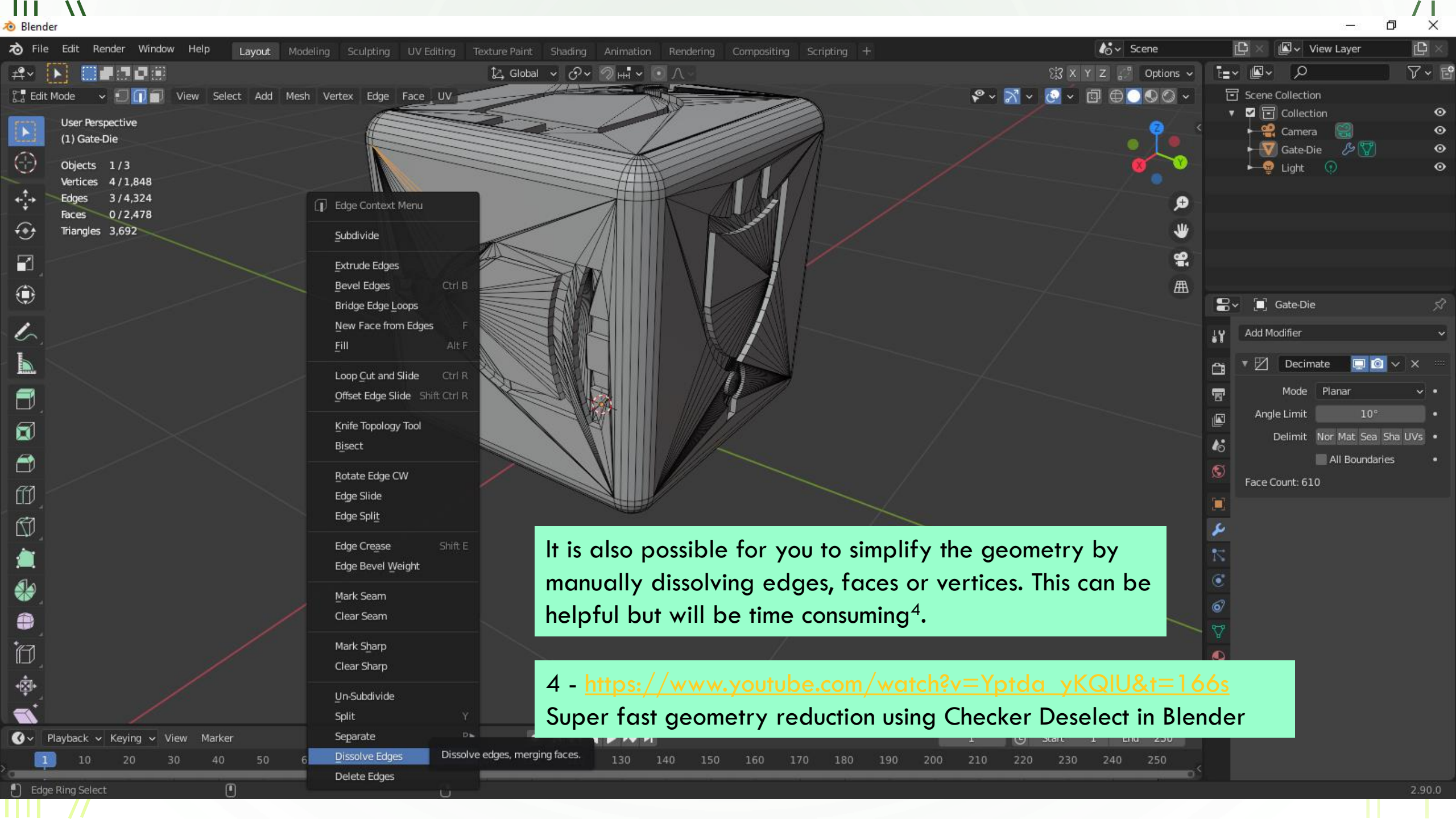
2 - https://docs.blender.org/manual/en/latest/modeling/modifiers/generate/decimate.html


Blender
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint Shading Animation Rendering Compositing Scripting
Scene
View Layer
Object Mode View Select Add Object
Global
Options
User Perspective
(1) Collection | Gate-Die
Objects 0 / 3
Vertices 371
Edges 1,052
Faces 683
Triangles 738
Scene Collection
Collection
Camera
Gate-Die
Light
Gate-Die
Add Modifier
Decimate
Mode Collapse
Ratio 0.2000
Symmetry X Y Z
Triangulate
Vertex Group
Face Count: 683
A YouTube video[3] suggested using “Collapse” and I selected a Ratio of 0.2. This reduced the complexity of the model significantly but we lose too much detail
bad
collapse = 0.2
371 Vertices
1,052 Edges
683 Faces
738 Triangles
3 - https://www.youtube.com/watch?v=JqolGxUrLbw Blender Tutorial - How to use the Decimate Modifier
Select
Ruler Add
Rotate View
Object Context Menu
2.90.0



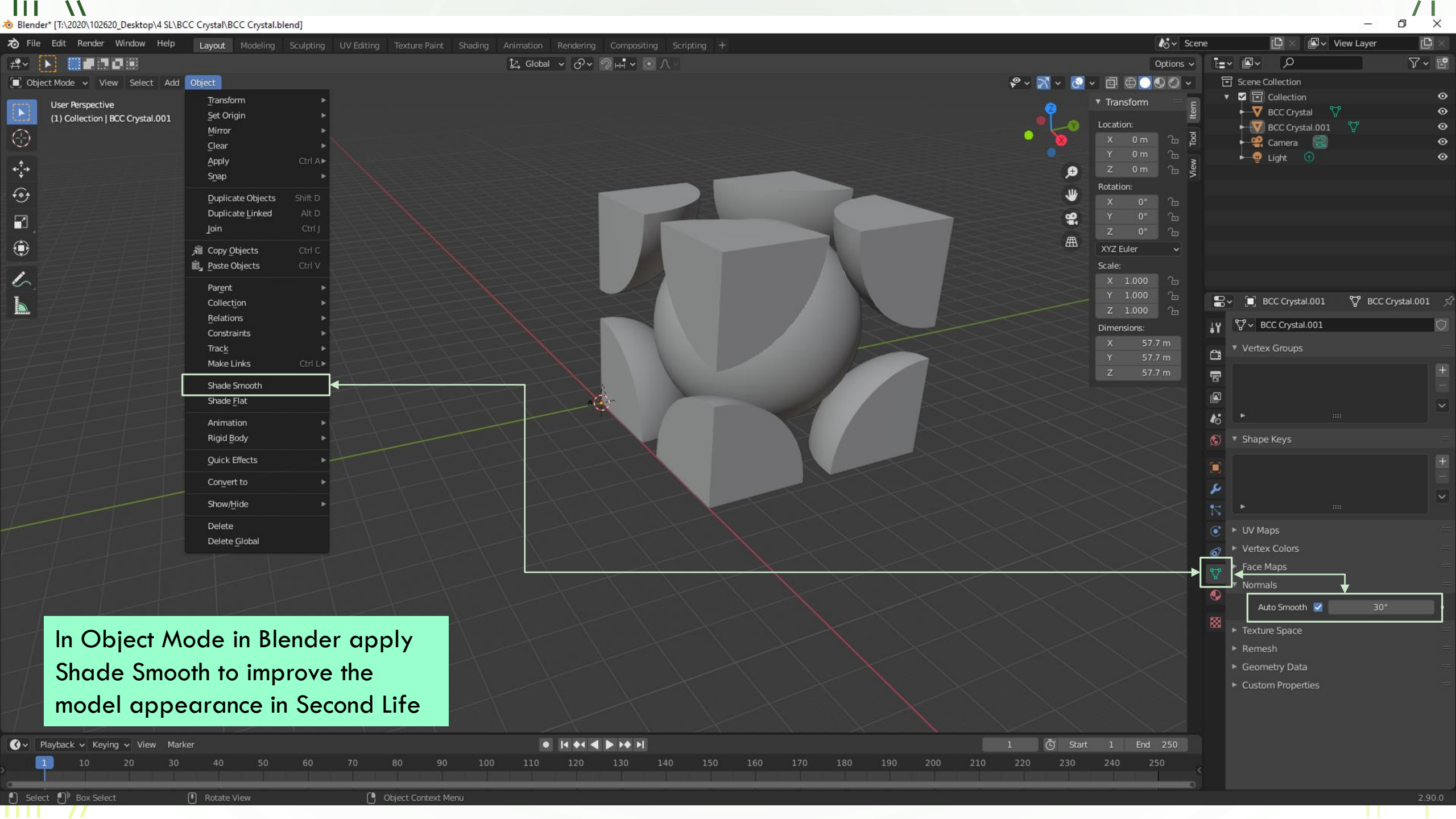
A trial and error approach is used to reduce the mesh. In this case both “Collapse” and “Planer” were tried. Mesh quality degradation would suggested that little more can be done with the model but this will not always be true.

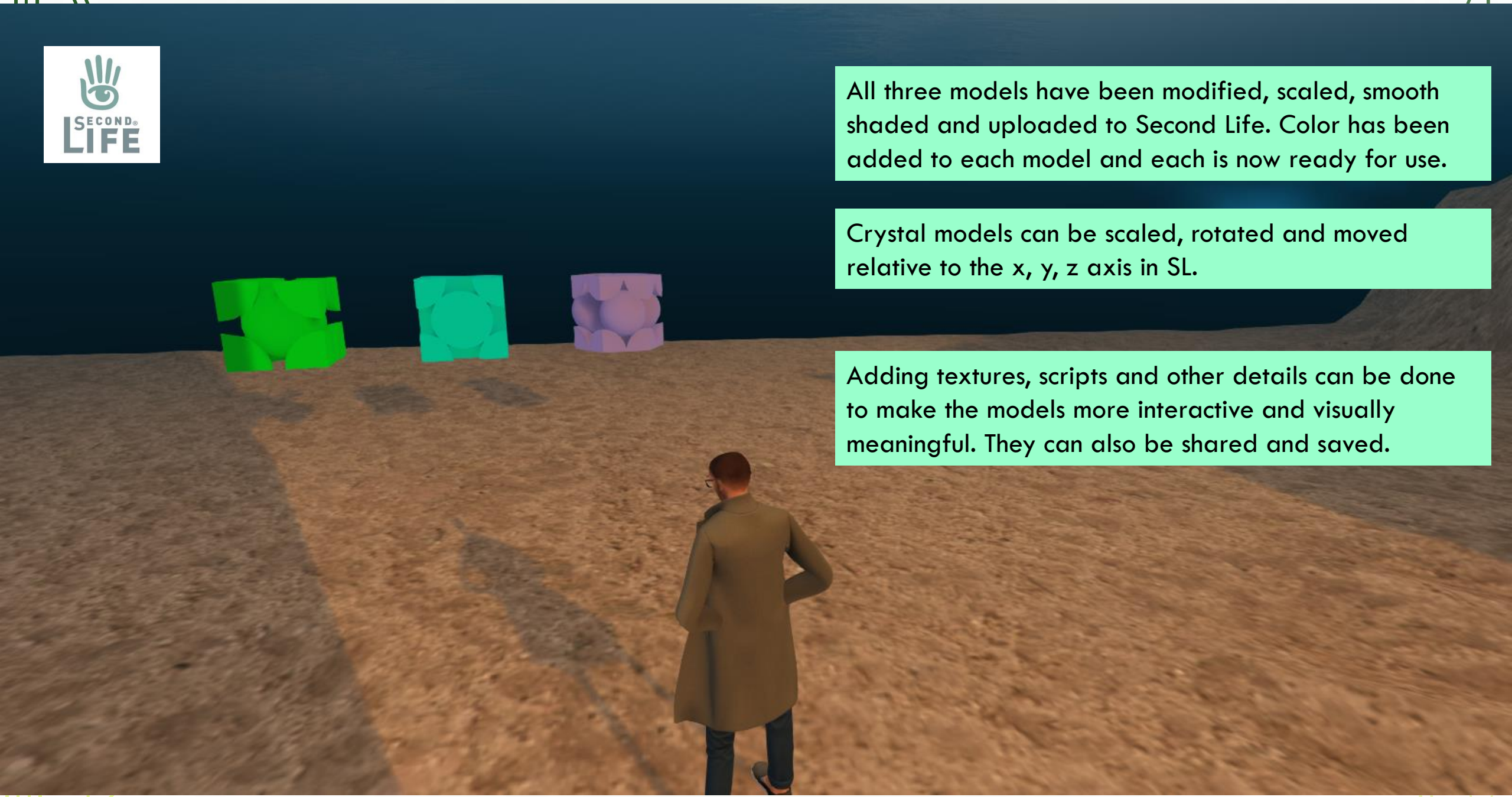
	ok	ok	bad	ok	bad
	Scaled	alt j	collapse = 0.2	planer=10°	planer=20°
Vertices	1,848	1,848	371	1,260	1,052
Edges	5,538	4,324	1,052	1,868	1,405
Faces	3,692	2,478	683	610	355
Triangles	3,692	3,692	738	2,516	2,100



It is also possible for you to simplify the geometry by manually dissolving edges, faces or vertices. This can be helpful but will be time consuming[4].

4 - https://www.youtube.com/watch?v=Yptda_yKQIU&t=166s
Super fast geometry reduction using Checker Deselect in Blender

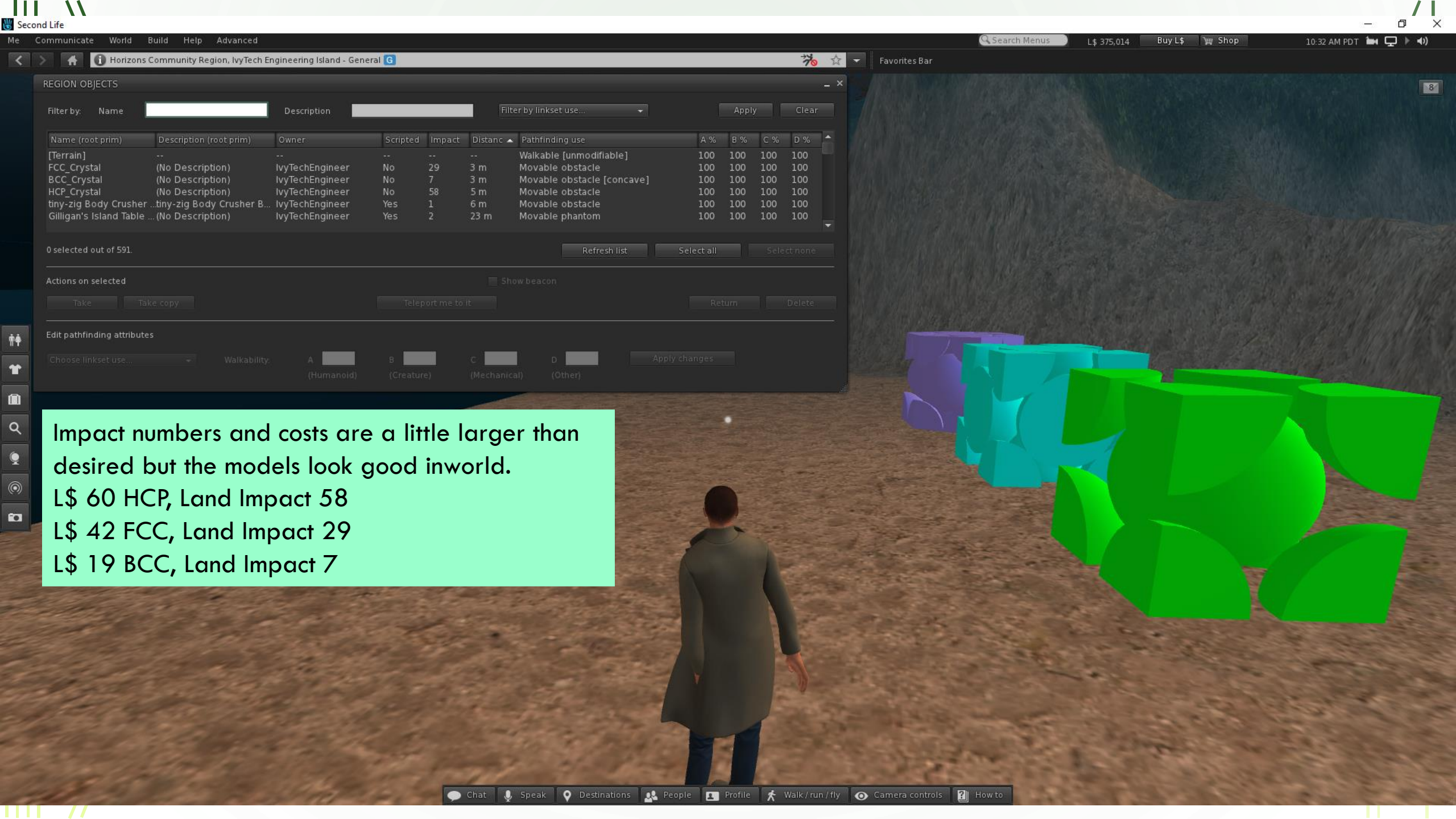

Blender* [T:\2020\102620_Desktop\4 SL\BCC Crystal\BCC Crystal.blend]
File Edit Render Window Help
Layout Modeling Sculpting UV Editing Texture Paint Shading Animation Rendering Compositing Scripting
Scene
View Layer
Object Mode View Select Add Object
Global
Options
User Perspective
(1) Collection | BCC Crystal.001
Transform
Set Origin
Mirror
Clear
Apply Ctrl A
Snap
Duplicate Objects Shift D
Duplicate Linked Alt D
Join Ctrl J
Copy Objects Ctrl C
Paste Objects Ctrl V
Parent
Collection
Relations
Constraints
Track
Make Links Ctrl L
Shade Smooth
Shade Flat
Animation
Rigid Body
Quick Effects
Convert to
Show/Hide
Delete
Delete Global
Scene Collection
Collection
BCC Crystal
BCC Crystal.001
Camera
Light
Transform
Location:
X 0 m
Y 0 m
Z 0 m
Rotation:
X 0°
Y 0°
Z 0°
XYZ Euler
Scale:
X 1.000
Y 1.000
Z 1.000
Dimensions:
X 57.7 m
Y 57.7 m
Z 57.7 m
BCC Crystal.001
Vertex Groups
Shape Keys
UV Maps
Vertex Colors
Face Maps
Normals
Auto Smooth 30°
Texture Space
Remesh
Geometry Data
Custom Properties
In Object Mode in Blender apply Shade Smooth to improve the model appearance in Second Life
Playback Keying View Marker
Start 1 End 250
Select Box Select Rotate View Object Context Menu
2.90.0



All three models have been modified, scaled, smooth shaded and uploaded to Second Life. Color has been added to each model and each is now ready for use.

Crystal models can be scaled, rotated and moved relative to the x, y, z axis in SL.

Adding textures, scripts and other details can be done to make the models more interactive and visually meaningful. They can also be shared and saved.



Impact numbers and costs are a little larger than desired but the models look good inworld.

L$ 60 HCP, Land Impact 58

L$ 42 FCC, Land Impact 29

L$ 19 BCC, Land Impact 7

Questions and References

https://www.ivytechengineering.com/abell118/references/BuildingVirtualWorld/

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