Using Meshmixer to Create 3D Designs for your Teaching Laboratory

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The ability to generate 3D objects in software is a skill growing in demand because of the new prevalence of 3D-printing technology. As this technology matures, it is becoming more useful to biology laboratory instructors, given the potential for useful teaching tools. Autodesk Meshmixer is a software package for manipulating the triangle mesh of 3D object files. In the workshop, we demonstrated how to edit 3D objects in the software for users who have no experience in design.

Keywords: 3D Models, Meshmixer, 3D Printing

Introduction

Currently, 3D-printing technology is on the rise as an inexpensive and flexible means to produce rapid prototypes and physical models of solid structures. Stewart and others (2017) demonstrated an example of using rapid prototypes of animal models in fish behavioral experiments in an introductory laboratory setting. Others have described how to use 3D-printing to teach about molecules (Gardner and Olson 2016), muscle cell structure (Bagley and Galpin 2015), and teeth fossils and paleontology (Bokor and others 2016). While a variety of ready-to-print 3D files exist for public use—many of them being free—a laboratory science teacher may have the need for customized models.

Numerous tools exist for users to develop their own 3D models, and in this workshop, we described the use of Meshmixer (Autodesk n.d.), software that allows the user to manipulate triangle-based meshes. This software is free to download, works with all common 3D digital formats, and is simple to use, given some introductory instruction. Because the idea of working with 3D models in software on a 2D screen with 2D interfaces intimidates many not in a design profession, some simple guided exposure can help to ease one into the practice of using this emerging technology..

Using Meshmixer

Meshmixer uses triangle-based meshes, which are series of points that attach to each other with lines that form linked triangles. Larger numbers of triangles in an area will give finer detail to a model but will also make storage and processing more resource intensive for a computer.

After installing Meshmixer from the file available on the website (Autodesk n.d.), users should start by selecting the rabbit shape ("Import Bunny") from the list. They can then manipulate and modify the object using the tools available. We recommend the users acquaint themselves with using the right mouse button to rotate the view angle, the middle mouse button to pan the view, and the mouse wheel to zoom in and out. After this, users should practice the following options:

- Select
    - Left click and hold the left mouse button to select areas of the object's surface.
- Select → Edit → Erase and fill
    - This option replaces selected surface features with a smooth surface.
- Select → Edit → Discard
    - This option deletes a selected section.
- Select → Edit → Reduce
    - This option simplifies the selected section to fewer polygons than it was before.
- Select → Edit → Remesh
    - This option increases the polygon count in the selected section and can be important for future surface editing.
- Select → Edit → Weld boundaries
    - This option repairs breaks in selected surfaces.

- Select → Edit → Separate
  - This option creates a new object from the selected region of the active object.
- Select → Deform
  - This option allows the user to organically twist and shape selected regions.
- Sculpt
  - This option allows the user to paint modifications onto an object's surface.
  - For most users, the brushes Flatten, Inflate, and ShrinkSmooth will be the most useful.
- Edit → Duplicate
  - This option creates a copy of an object.
- Edit → Transform
  - This option allows the user to move and rescale the object. It is an excellent way to learn Meshmixer's control interface.
- Edit → Plane Cut
  - This option allows the user to sever an object into two shells.
- Edit → Separate Shells

- This option creates new objects from the shells within an object.
- Edit → Combine
  - This option combines multiple selected objects.
- Edit → Boolean Difference
  - This option subtracts the volume of one object from another. It is a fine option for generating holes.

- We also provided information about other resources that are available to potential users, including:
- The Autodeks Meshmixer 101 playlist: https://www.youtube.com/playlist?list=PLu8TYSQ5jCFjdQBHsLoybhdKXOTmpTRlb
- Sketchup
  - http://www.sketchup.com/
  - More for architecture and handles blocky objects better than Meshmixer
- Blender
  - http://www.blender.org/
  - For animated films and games

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Acknowledgments

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Citing This Article

Stewart JF, Osburn F, French DP. 2018. Using Meshmixer to Create 3D Designs for your Teaching Laboratory. Article 56 In: McMahon K, editor. Tested studies for laboratory teaching. Volume 39. Proceedings of the 39th Conference of the Association for Biology Laboratory Education (ABLE). **http://www.ableweb.org/volumes/vol-39/?art=56**