The modifier list continues to grow with each new release of Blender. We have already discussed the Subdivision Surface (SubSurf) and Ocean modifiers in previous chapters and will now look at some of the other modifiers. Others will be discussed in later chapters. Depending on the type of object selected, the modifiers fly-out may display different options. For basic meshes, here is what you see:

**Generate Modifiers**

Some of the Generate modifiers are self-explanatory while others need more discussion. Here are some of the basic options:

**Array**

The Array modifier works great for making patterned copies of an object. If you need rows and columns, add 2 Array modifiers and set the X,Y,Z Offsets as needed to obtain your pattern. By checking the “Object Offset button and selecting a control object (like an Empty), you can spin and scale the array.
Chapter 13 - Modifiers

**RoboDude Asks:** What does the “Apply” button do in a Modifier panel? Until you hit apply, you can always change the settings of the feature. Once you hit the apply button, the modifier panel disappears and the feature becomes fixed and unchangeable. For example, applying a bevel modifier will then fix the bevel, changeable only in edit mode by moving vertices or faces. Same effect as applying the mirror modifier.

**Bevel**
The Bevel modifier will apply a bevel, or chamfer, to the edges of simple meshes. There are a few options that can be set.

**Boolean**
The Boolean modifier is an important feature. It allows you to cut holes, join meshes that recalculate vertices and create new shapes from shared areas. To use the Boolean modifier, create 2 shapes- one that will be effected and one that will cause the effect. For my example, I’ve created a cube and a sphere. If you want to see the effect on the cube, select the cube and add a Boolean modifier. In the “Object” box, select the “Sphere”. Under “Operation”, select “Intersection”, “Union”, or “Difference”. When you get your desired results, hit “Apply”. Sometimes, you don’t get exactly the results you desire and need to erase some faces or move some vertices in edit mode. See results below:

**Build**
The Build modifier will take a mesh and build, or create, it over a specified time. Use the subdivide command to add more faces for a better effect. You can control the start and end frame times, randomize and seed pattern. A useful effect for having something appear and build in an animation.
Decimate
Let’s say you made an object and subdivided it too many times or need to simplify it for using in the game engine. Changing the “Ratio”, then hitting the “Apply” button will simplify the mesh.

Edge Split
Edge split allows you to split a mesh into individual faces. Basically, you are taking the shared vertices at intersections and duplicating them so all faces have their own set of points. Edges are split depending on the angle setting. Hit “Apply” to see results, then enter “Edit Mode” to select those faces.

Mask
The Mask modifier allows you to select a vertex group previously created for the selected mesh and filter out everything else, or just that group. To create vertex groups, you need to go to the “Object Data” panel, create a new group and assign selected vertices to that group. Vertex groups are used for many features in Blender, some being demonstrated in later chapters. After the group has been created, you can add the Mask modifier, select the group and any other desired features like the “Invert” option.

Mirror
When modeling a symmetrical object (like a face, body or car), it is useful to only model half the object. To do this, move the object’s center point to the objects mirror axis and keep all vertices to one side of the mirror axis. Add a Mirror modifier and select the X,Y, or Z (or multiple) axis planes and other options. You can also use another object to mirror around. After you have shaped the object, hit “Apply” to set the mesh.

Multi-resolution
Multi-resolution allows you to add different levels of resolution quality to a mesh as rendered and displayed on the screen. Useful for speeding up working and rendering.

Screw
The Screw modifier allows you to create spiral objects differently than the “Screw” option found in the Tool Shelf in edit mode. The screw modifier works best with flat 2D objects like planes. By default, the feature uses the object’s center point as it’s spin reference, but other objects can be selected. You can select the spin axis, angle, step quality, and turns (iterations).
Chapter 13 - Modifiers

Solidify
If you are making an object like a glass or mug, if you only extrude the outer face of the object, it will not have any thickness. The Solidify modifier allows you to give the object some wall thickness.

Subdivision Surface
The “SubSurf” modifier allows you to keep your mesh simple with as few vertices as possible, but render as a much more detailed mesh. Try adding a monkey head mesh, hit “Smooth” in the Tool Shelf, then add a Subdivision Surface modifier. If you enter Edit Mode, the mesh is still simple, but SubSurf has divided the faces for more detail. Be careful not to take the setting too high or your scene will slow down.

Deform Modifiers
While the Generate modifiers allowed certain modifications to the object, the Deform modifiers are used to change the object or use other objects for control.

Armature
An armature is a skeleton used to deform a mesh. It can be used for creating characters, suspension on cars and much more. Armatures are discussed in more detail in a later chapter.

Cast
The Cast modifier can be used to round or square a mesh. The example to the left used a UV Sphere and a cast type of Cuboid. The sphere has started to take on the shape of a cube. Make sure you have plenty of vertices to get a desirable shape.

Curve
The Curve modifier allows you to use a curve to shape a mesh. Start by creating a mesh that is subdivided or extruded with enough vertices to “bend”. Create a curve and apply the Curve modifier to the mesh (not the curve). Shaping the curve will bend the mesh.

Displace
The Displace modifier works like the Displacement setting in the Textures panel (discussed in the Materials and Textures chapter). Create an object with many vertices, apply a texture and use it with the Displace modifier. The example to the right is a cube.
Hook
Hooks are used to animate an object using another object. Often, you will create vertex groups (discussed in Chapter 13 and 16) and tie them to an object, like an Empty. With the object selected and in Edit Mode, you can “Reset” and “Recenter” the mesh’s points for better interaction.

Mesh Deform
The Mesh Deform Modifier allows you to “Bind” one mesh to another and use it to control it’s shape. Vertex groups can also be assigned for control. In order to use it, the controlled shape (the shape with the modifier on it) must be contained within the control object and the control object must be a closed mesh. Depending on the complexity of the meshes, the computer may lag when the “Bind” button is pressed.

Shrinkwrap
Shrinkwrap is a relatively new modifier that allows you to wrap a mesh around another mesh. For example, a subdivided plane can be molded around another object. You can select a target object to wrap around and a vertex group to control the shape.

Simple Deform
Simple Deform is a handy modifier that can do a variety of simple modifications to a mesh. You can Stretch, Taper, Bend and Twist a mesh using the Mode and Deform settings. The complexity of the deform can relate the the number of subdivisions and vertex groups used.

Smooth
The Smooth modifier will attempt to smooth out a mesh or vertex group that may be sharper than you wish.

Wave
The Wave modifier is a useful modifier for animating a simple oscillation effect. You can control the axis of the wave, speed, height, width and narrowness. If you start with a simple plane, you will need to subdivide it to see the oscillation. This is an animated effect so press “Alt-A” to see the results of your settings. A simple way to make a ripple.
Simulate Modifiers
The *Simulate* modifiers work with Blender's physics engine in order to create animations dealing with particles (fire, explosions, strands), cloth, fluids, soft-bodies, smoke, forces and collisions. When applying most of these modifiers, you will need to go to the *Physics and Particles* panel to adjust the settings. All of these factors are discussed in later chapters, but here is what you can find in this modifier stack:

**Cloth and Collision**
The Cloth modifier can make a mesh act like fabric. The more vertices your mesh contains will make it appear more realistic, but at a cost of render time. The Collision modifier allows other objects to react with the cloth (also works with particles). The example shown uses a subdivided plane as the fabric and the sphere as the collision obstacle.

**Particle and Explode**
Particle systems are used to simulate many animation effects and discussed in their own chapter. Particles can simulate explosions, sparks, fire, smoke, grass, hair, and fireworks. After adding a particle modifier, you can then add the explode modifier to “explode” the mesh along with the effect.

**Fluid Simulation**
The fluid simulations have seen improvements over previous versions. You can create inflow or fluid masses that splash and react.

**Soft Body**
The Soft Body modifier existed before Blender had the Cloth modifier and was used to simulate cloth effects. Soft bodies can be used for fabric effects and “Jello” giggle effects. You can control the elasticity between vertices.

**Smoke**
The Smoke modifier was new for Blender 2.5. It can be used to create realistic smoke effects in your scene.
SoftBody
The Softbody modifier is controlled in the Physics panel and allows objects to flex and lose some rigidity, like Jello gelatin or fabrics. The cloth simulator was born out of softbodies several years ago to simplify the fabric process. The example shown to the right is a sphere being deformed by the wind.

Ocean
The ocean simulator can be used to create a very realistic-looking ocean. We used the ocean simulator for our lighthouse scene earlier in the book.

There are many more modifiers than we have discussed here and more will probably be added shortly after this book is published. Remember to look at www.blender.org and YouTube for more information about modifiers.

Mesh Errors and Modifier Problems

RoboDude Asks: I tried to use a Boolean modifier and it doesn't work- why?
For a Boolean modifier (and many other modifiers) to work, you need to have a clean mesh without double vertices or flipped faces. For Boolean operations, the mesh must also be closed and solid with no missing faces to work correctly.

There are several Tool Shelf commands you may want to use if you encounter mesh problems, especially with Boolean operations. With the mesh selected, enter Edit mode, select all vertices, then:

• In the Tools tab on the Tool Shelf, select “Remove Doubles”.
• In the Shading/UVs tab, select “Recalculate” under Normals to force the mesh to determine the correct direction of the faces.
• Finally, check to make sure there are no holes or overlapping faces in your mesh.

This will solve most modifier problems.
Create a new file and call it *Modifiers*. Create a scene using any objects and materials you wish. Place at least one of each of the following modifiers in your scene.

- Subdivision Surface
- Build Effect
- Mesh Mirroring
- Wave Effect
- Boolean Operation

Feel free to experiment with any of the other *Generate* and *Deform* modifiers.

*Render a 200 frame movie of your scene when finished.*

**Other useful commands:**

"Alt-C" to convert a curve or text to a mesh.

*Tool Shelf* command: move the Origin to a better location when using the mirror modifier.

**Call the instructor when finished**
Scenario:
An entomologist discovers you are a skilled 3D computer artist and commissions you to create a 3D model of an insect they are studying. Your goal is to create a 3D model of the insect with as much detail as possible.

Goal:
Find images of an insect on the internet that you would like to model. Use Blender modifiers to assist you with the modeling process (i.e. Mirror, Boolean, Smooth, SubSurf, etc.). After you finish modeling the mesh, add appropriate materials and textures. You can find many examples of insects made in Blender on the internet for inspiration and guidance.

When finished, add appropriate lighting, world settings and other scene elements. Render and save an image.

**Call the instructor when finished**
Chapter 13 Reflection and Wrap-up:

Blender Modifiers

Modifiers have been designed to make your modeling experience go much smoother, producing interesting results that would otherwise be very difficult to create. Take a few moments to reflect on these questions.

1. From the modifiers that you experimented with, which did you find to be the most interesting and useful? Why?

2. The Build modifier can be used for some interesting effects. From your own thoughts, describe one possible use for the Build modifier.

3. The mirror modifier is useful for more than just mirroring an insect. Name at least 5 situations where the mirror modifier would be useful.

4. Boolean operations form the basis for not only many 3D modeling tools, but computer logic in general. Do some internet research on Boolean mathematics. George Boole was a man ahead of his time. What is Boolean logic and why is it so important for computers? Explain.