- **Close** the Hypershade.

Save your work

- **Save** your scene as *02-body_01.ma*.

odel the torso

v that image planes have been created in the scene for reference, the model building can t. The torso will be modeled from a polygon cube. Initially, the torso shape will be blocked nd used to represent the overall general shape.

Create a polygon cube

- Make the *front* view active.
- Turn **Off** the **Create → Polygon Primitives → Interactive Creation** option.

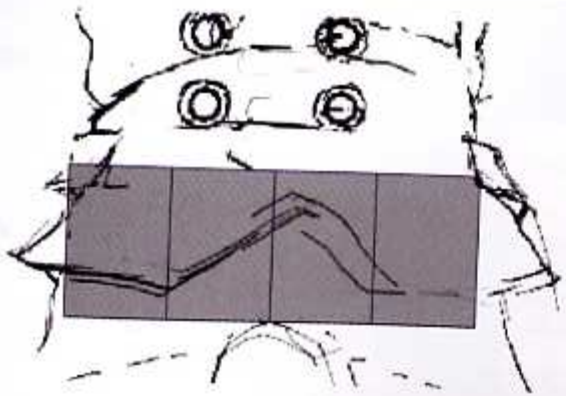
  When enabled, this option lets you drag in the viewport to create a piece of geometry. It will not be used in this case.
- Select **Create → Polygon primitives → Cube →** ❑, and set the following:

  Width divisions to **4**;

  Height divisions to **1**;

  Depth divisions to **3**.
- Click the **Create** button.
- **Move** and **scale** the cube so it is placed at the base of the torso at the waist position, and is approximately the width and thickness of the torso.

p: *Do not translate the cube on its X-axis. You want to keep the central line of your character at zero on the X-axis so you can model symmetrically.*



itial cube

Note: *In your viewports, under* **Shading → Shade Options**, *you should set* **Wireframe on Shaded** *and* **X-ray** *modes to* **On**. *This setup will allow you to modify your geometry and see the image plane reference. It will also allow you to assess the flow of the polygon topology.*

2 Symmetrical editing

A character is typically symmetrical across the center line of the torso. When modeling a symmetrical object, you will want to edit both sides of the object at the same time. In order to simplify this task, the Move, Rotate, and Scale Tools have the option to reflect any component edits across the origin.

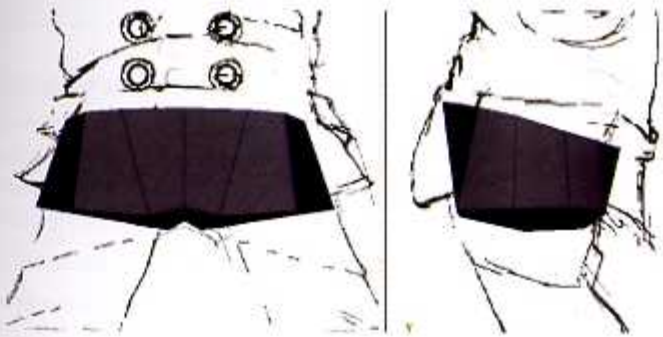
- **Double-click** on the **Move Tool** in the toolbox.
- In the **Move Reflection Settings** section of the Tool Settings window, turn **On** the **Reflection** option and set the **Reflection axis** to **X**.

  The tool will look for matching components according to the defined tolerance. The reflected components will be highlighted for convenience.

Note: *This option also controls the* **Reflection** *feature of the* **Rotate** *and* **Scale** *Tools.*

3 Tweak the cube vertices

- With the cube still selected, press the **F8** hotkey to display the cube's vertices.
- **Move** the vertices of the cube to better represent the waist and pelvic regions of the character. Try to model the pelvis as it would be under the coat.



The waist area

Tip: *Remember to make your adjustment in the front and side views. A quick way to switch between the different views is to use the* **View Cube**, *located in the top-right corner of the Perspective view.*

- Press **F8** again to go back to Object mode.
- **Rename** the cube to *body*.

Extruding the torso

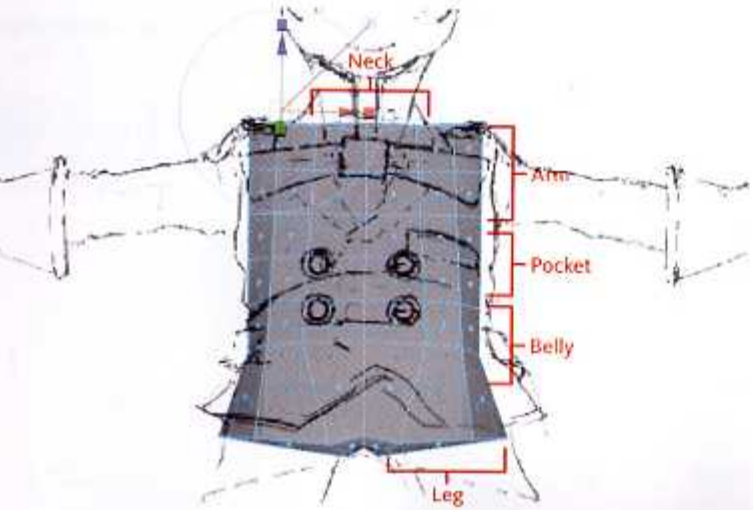
The next step is to create the initial overall shape for the rest of the torso. **Extrude Face** will be used for this step. Multiple extrusions will be used to define the shape at key points moving up the torso.

- Press **F3** to display the **Polygons** menu set.
- Enable the **Edit Mesh Keep Faces Together** option before extruding.
- With *body* selected, press **F11** and select the faces at the top of the torso.

> **Note:** *Because of the reflection setting, the vertices will be highlighted yellow. This will not affect any of the following steps.*

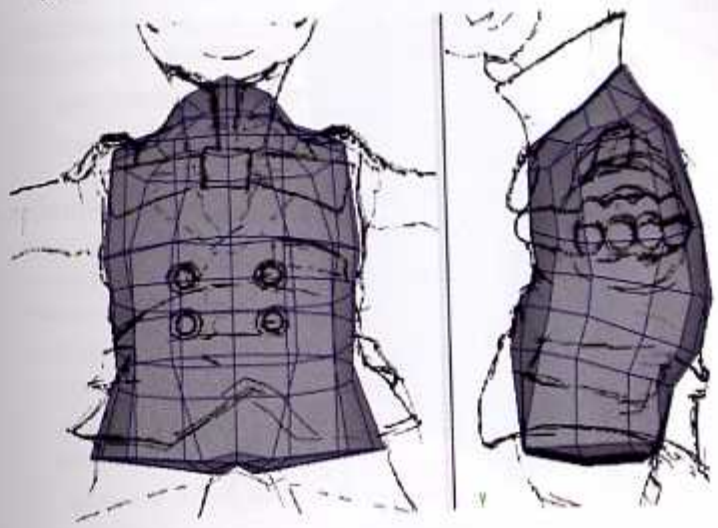
- Select **Edit Mesh → Extrude**.
- **Move** up the extruded faces all the way to the base of the neck.
- In the **Channel Box**, set **Division** to **5** for the *polyExtrudeFace1* node.

Doing so defines horizontal lines at important places such as the belly, the pockets, the arms, and the base of the neck. The overall topology of your mesh should now be able to extrude the arms, the neck, and the legs properly.



trude up the torso

- **Move, rotate,** and **scale** the vertices in order to match the front and side profile shapes of the torso.



Torso adjustments

The base shape of the torso has now been established. You will notice that the overall form is still cubic. In the next step, you will start adjusting rows of vertices to further round off the shape. You will also adjust rows of edges to better follow lines of topology.

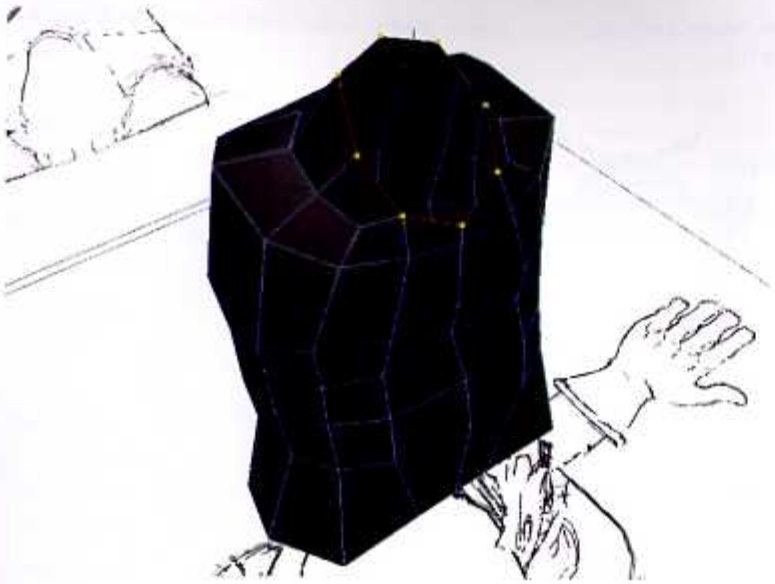
> **Tip:** *You may notice that the image you are working with is not perfectly symmetrical. You should concentrate on just one half of the image.*

5 Adding detail to the upper torso

The torso has been defined as well as possible with the current amount of topology. The next step will be to add detail to better define areas. The best way to do this is to work one area at a time. The first areas will be the shoulder and neck, followed by the upper back and chest.

- Select the faces at the neck location and **delete** them to create the neck opening.
- **Move** the vertices of the neck to round up the opening.

  Make sure the vertices at the bottom of the neck follow the line along the shoulder muscle that runs up into the neck.



Neck refinements

- Continue tweaking the shape to your liking.

6 Save your work

- **Save** your scene as *02-body_02.ma*.

Symmetrical edits

As you have just experienced, a character is typically symmetrical across the center line of the torso. Depending on the tools you are using, it can be tedious to always make sure both halves of your model are identical. This is true especially when adding topology to the model, as there are no symmetry options for certain tools, like the Split Polygon Tool, for instance. A nice workflow to avoid this pitfall is to delete half the torso and create a mirror copy to represent the entire model.

1 Mirror the torso

- Select and **delete** the faces on the right side of the *body*.
- Go into **Object mode** and with the half torso selected, select **Edit → Duplicate Special →** ❑, and set the following:

  Geometry Type to **Instance**;

  Scale X to **−1**.
- Click the **Duplicate Special** button.

  Any adjustments done to one side of the torso will simultaneously be done on the other side.

2 Backface culling

Currently, the front and back edges, faces, and vertices are all visible in the viewports. This could be confusing when adjusting the topology. The following step will hide any faces that face away from the camera:

- Select **Display → Polygons → Backface Culling**.

  Now only the front faces are visible in the view.

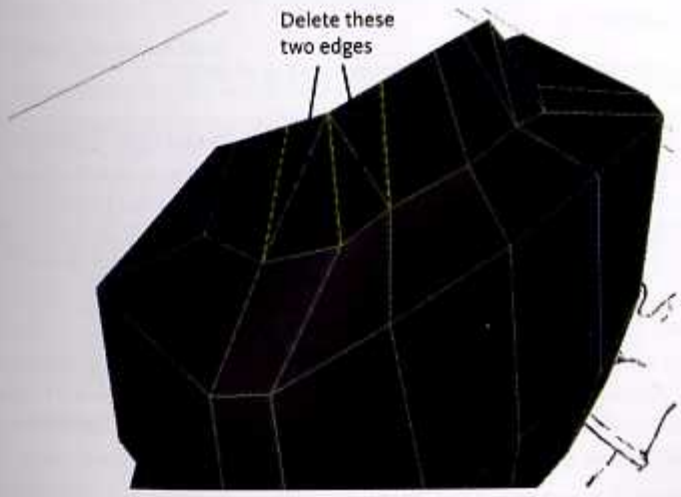
3 Splitting polygons

When refining a model, you get to a point where you need more components to work with. Plenty of polygonal tools will let you do this; for this lesson, you will now look into the Split Polygon Tool.

- With the *body* geometry selected, select **Edit Mesh → Split Polygon Tool** to create new rows of edges.
- From the *top* view, **click+drag** on edges to define the line that separates polygons to define quads in the back of the neck.

  Notice how the split was also added to the mirrored half of the body.
- **Delete** the edges forming triangles in order to leave only quad faces using **Edit Mesh → Delete Edge/Vertex**.

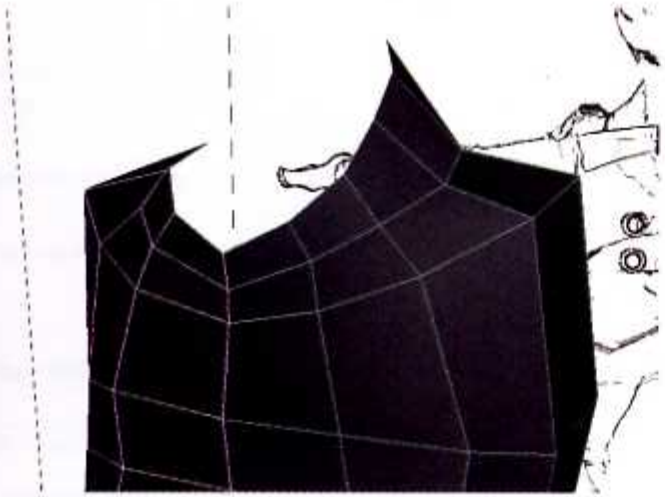
  This command will work better than simply pressing **Delete** *on your keyboard since it also deletes the unnecessary components associated with the edges.*



The back of the neck splits

Tip: *When splitting polygons, you should try as much as possible to create quads. Quads are polygonal faces with four edges and four vertices. When this is not possible, you should divide faces to create as few triangles as possible.*

- Also **split** and **delete** edges on the front of the neck opening in order to create a nice flow of quads.



The front of the neck topology

- Continue to move vertices to better define this new line of detail.

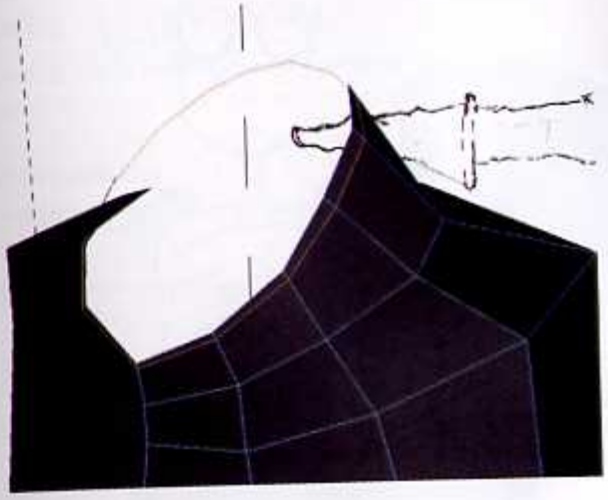
Note: *You may notice that with each new split and adjustment, other slight adjustments are needed to keep the topology clean. You will always be going back and moving vertices in order to improve the shape. This is a natural and expected part of the workflow.*

4 Refine the collar

The entire region around the neck does not have enough detail at this point to continue. The jacket collar should have a border going towards the inside, and then the shirt collar should be extruded up along the character's neck. You will now continue to add as few edges as possible in order to get as much detail as possible.

- Select **Edit Mesh → Insert Edge Loop Tool**.
- **Click+drag** on any vertical edges going into the neck opening to create a new edge loop very close to the actual neck opening.

  This creates a new row of edges traversing any four-sided polygons.



The edge loop split

- Use the newly added vertices to shape the border around the neck.

5 Extrude the neck

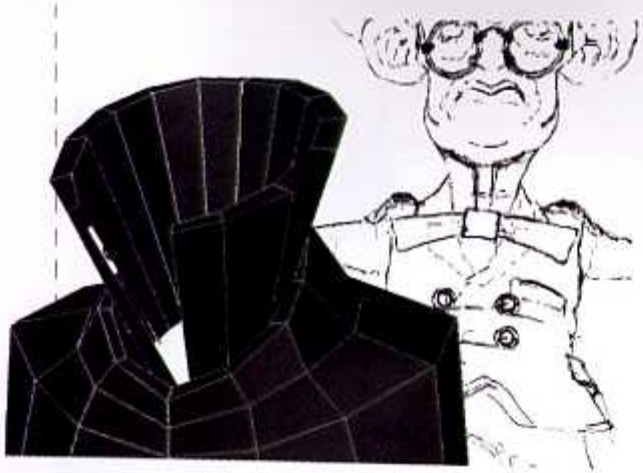
- **Select** the border edges that are forming the neck opening.
- Select **Edit Mesh → Extrude**.

  You can also extrude edges, which is perfect in this case
- Select the **Move Tool**.

  Doing so changes the manipulator to global transformation instead of local to each face.
- **Translate** the extrusion down to form the collar.
- **Scale** the extrusion down to tighten the neck.

Tip: *It will be difficult to scale the components without moving the central vertices away from the X-axis. Do not worry about these at this time, as you will be snapping them later in this lesson. Simply try to keep them in the central area.*

- Press the **g** hotkey to extrude the edges again.
- **Translate** the edges up in global space to create the shirt collar.
- Press the **g** hotkey to extrude the edges again and **scale** them to create the collar border.
- Press the **g** hotkey again to extrude the edges down to create the inside of the collar.



The extruded collar

You will now stop extruding the neck since it will be part of the head creation in the next lesson. The initial work is now done for the torso. Additional splitting of edges and tweaking of vertices will be required once the arms and legs are added.

Tip: *If you would like to get a sense of the torso with more topology, press the* **3** *hotkey to view the geometry in Smooth Preview. You can then press the* **1** *hotkey to go back to regular display before continuing.*

6 Save your work.

- **Save** your scene as *02-body_03.ma*.

The torso

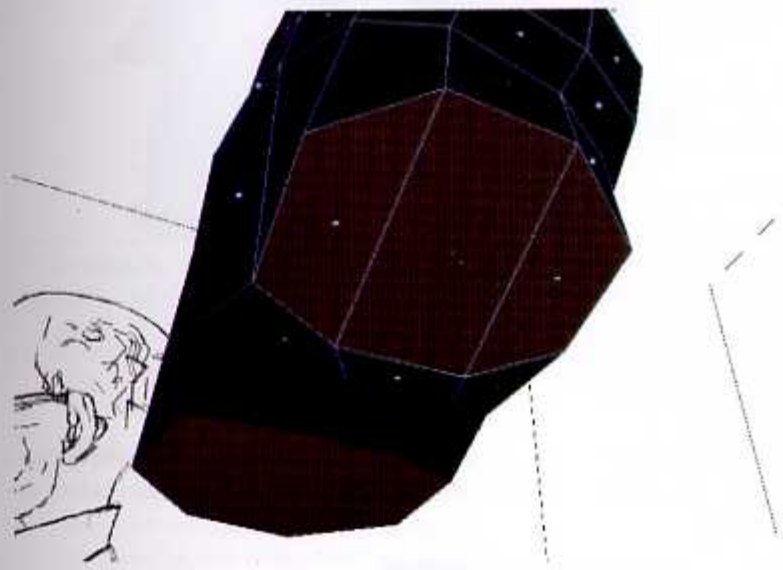
Model the leg

The character's leg will be modeled in a very similar fashion to the torso. Extrusions will be used to establish the overall shape, and vertices will be moved to refine the model.

1 Prepare the pelvic area

Before you extrude the legs, you need to ensure the faces to be used for extrusion are well determined.

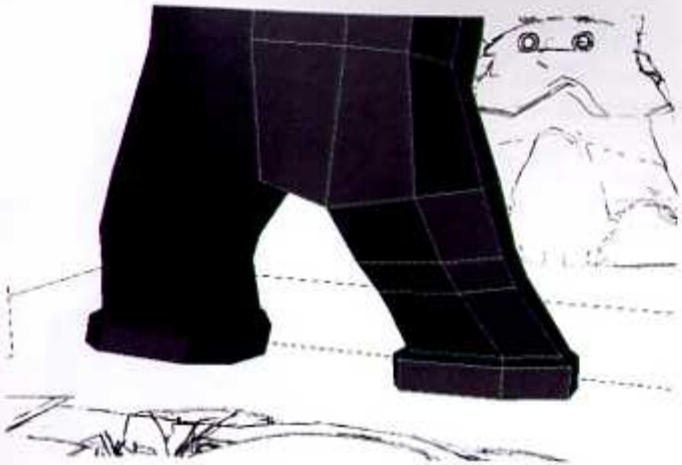
- Tweak the bottom vertices under the torso to create a hexagon using three faces.



The faces to be extruded

2 Extrude the leg

- With the leg faces selected, select **Edit Mesh → Extrude**.
- **Extrude** the leg down **six** times: to the top of the knee, below the knee, the middle of the lower leg, the pant cuff border, the bottom of the ankle, and the inside of the pant cuff.

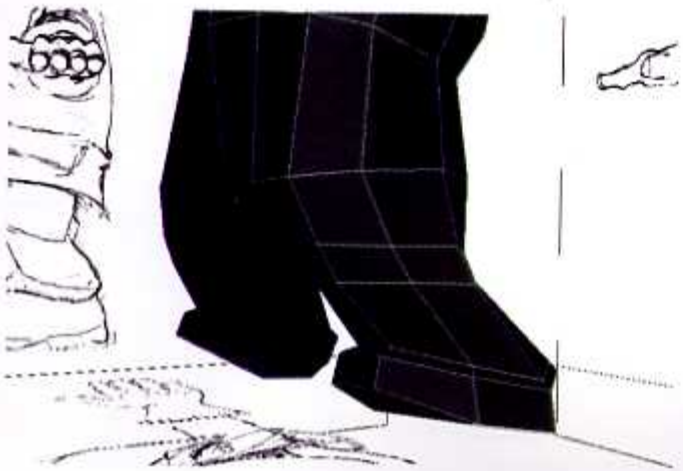


The rough legs

Tip: *As you are extruding, you may want to switch the manipulator to* **Global** *mode by clicking the small round icon attached to the manipulator. This icon is called the "cycling index."*

3 Shape the leg

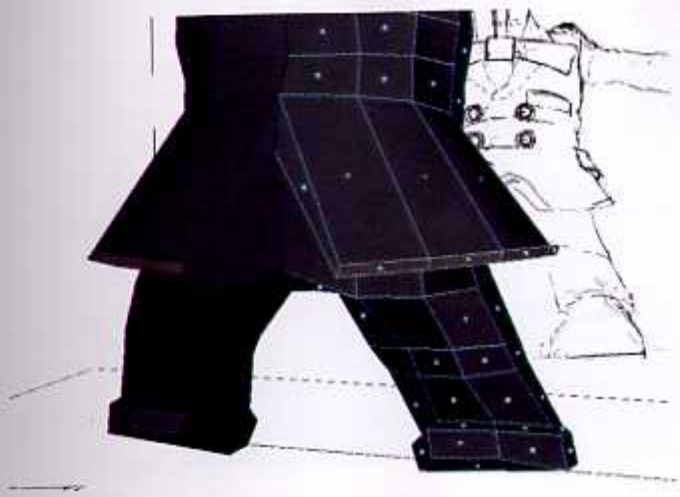
- **Move** the leg vertices to define the shape of the leg, making sure that you keep the rows of vertices perpendicular to the leg. Try to avoid twisting the vertices as they run down the leg.



The refined leg shape

4 Finalize the lower body

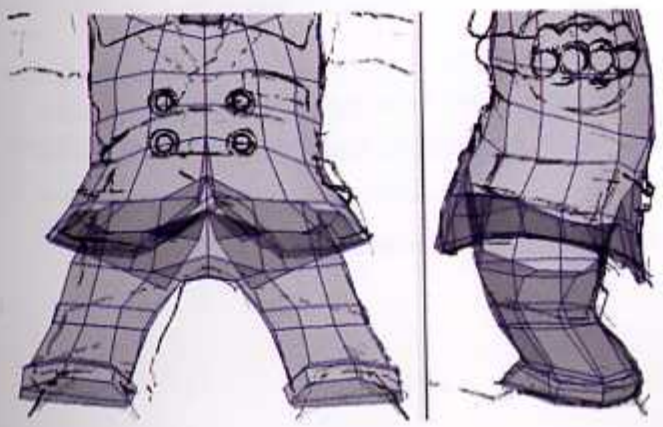
- Select the ring of faces around the waist and **extrude** them down to create the coat border.



The coat extrusion

- Use the **Insert Edge Loop Tool** to add a line of vertices in the middle of the extrusion from the last step.
- **Move** vertices to continue refinement.

  While modeling the coat, make sure to move the inner-coat as far as the coat surface. Doing so will prevent interpenetrations from occurring when the coat is deforming. As well, make sure to define faces to be extruded for the side pocket.



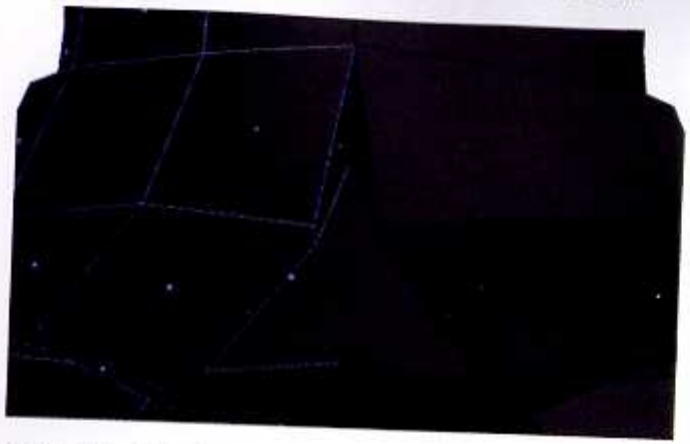
The refined coat geometry

- **Extrude** the pocket faces out.

5 Correct the center line

You might want to close the coat extrusion in the lower back. To do so, you simply have to delete the faces located inside the extrusion, and snap the vertices on the center X-axis.

- Select the face located inside the coat split in the lower back.



The face to be deleted

- Press the **Delete** key.
- **Move** the vertices closer to the central line of the character.

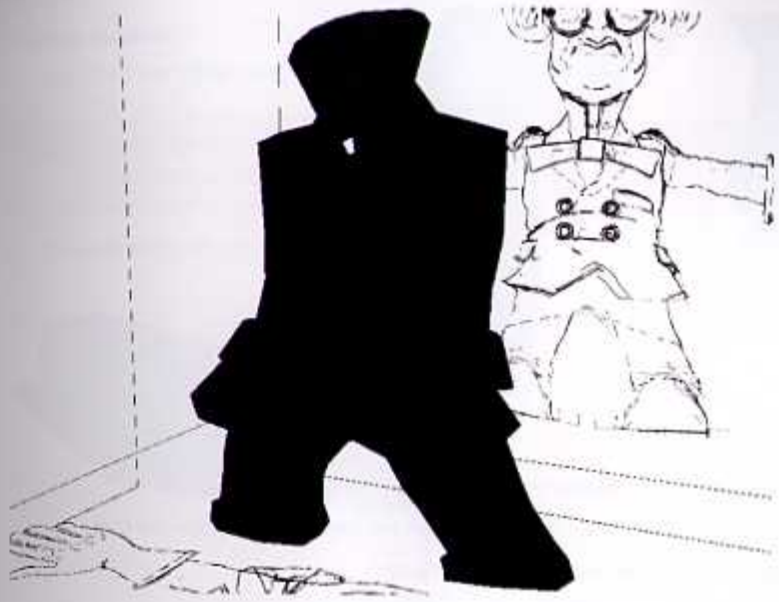
6 Snap the vertices

- While in *front* view, select all the vertices that should be on the central line of the character.
- **Double-click** on the **Move Tool** in the toolbox and disable the **Retain Component Spacing** option.
- Hold down the **x** hotkey to snap to grid.
- **Click+drag** on the **X-axis** arrow to snap the vertices to the grid's X-axis.

The central line of the character is now perfectly straight and aligned with the grid's X-axis.

7 Soften the model

- Select *body* and then select **Normals → Soften Edge**.



The soften model

- **Delete** all the construction history in the scene.

8 Save your work

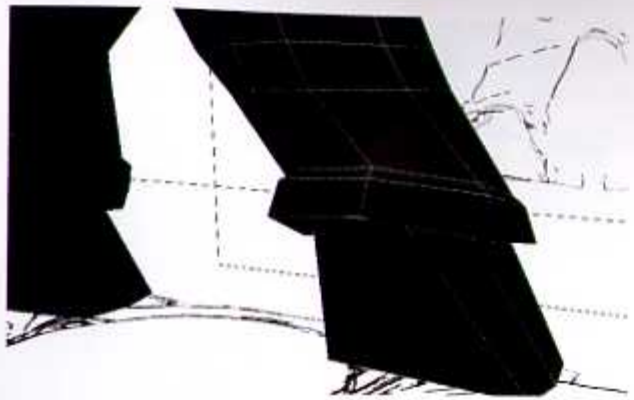
- **Save** your work as *02-body_04.ma*.

Model the shoe

A series of extrusions will be used to create the Constructor's shoe.

1 Extrude the shoe

- Select the face underneath the cuff.
- **Extrude** them going straight down to create the heel.
- **Scale** the extrusion on its **Y-axis** to flatten the faces.
- **Tweak** the new vertices to end up with a single face to extrude the front of the shoe.



The heel extrusion

- **Extrude** three times to create the front of the shoe.
- **Move** the vertices of the foot to spread out the topology and shape the foot.
- **Refine** the sole of the foot as much as you can.

The extruded shoe

2 Isolate select

Working on geometry that is partially inside or hidden by another object can be quite difficult. In order to simplify the foot refinement process, you will isolate the foot geometry. This means that you will tell Maya to display only certain faces in the viewport.

- Select all the faces of the shoe.
- In the *Perspective* view, select **Show → Isolate Select → View Selected**.

  Only the selected faces are now visible in the viewport.
- To exit the **Isolate** mode, simply disable **Show → Isolate Select → View Selected** in the viewport.

3 Refine the shoe

- Use the **Insert Edge Loop Tool** to refine the shoe geometry.

> **Tip:** *Use the construction history of the polySplitRing node to scale the new edges by using the* **Curve Input Offset** *attribute in the* **Channel Box**.

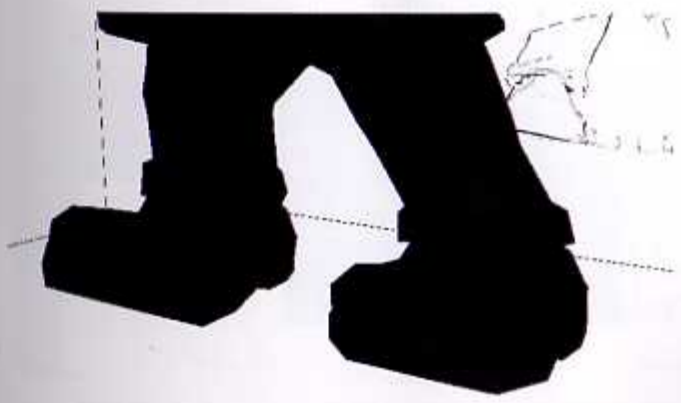
- **Extrude** the heel one more time to give it some thickness.

The isolated shoe

- When you are done, disable **Show → Isolate Select → View Selected**.

> **Note:** *When creating new polygons, it is possible that they have become invisible due to the isolate state. To correct this, you must toggle off* **View Selected**, *reselect the proper faces, and then isolate the faces again.*

4 Finalize the shoe



The finished shoe

5 Save your work

- **Save** your work as *02-body_05.ma*.

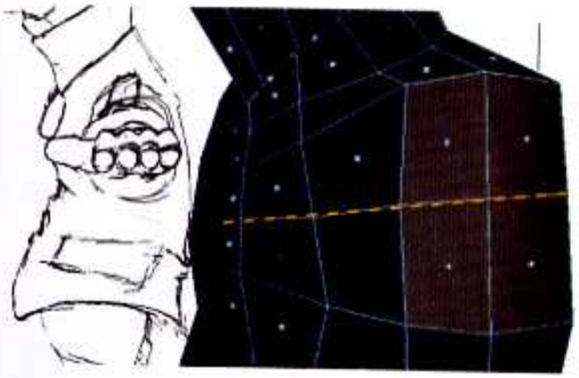
Model the arm

The arm of the character will be modeled in a fashion similar to the torso and leg. Extrusions will be used to establish the overall form, vertices will be moved to refine the shape, and polygons will be split only where absolutely necessary.

1 Arm extrusion

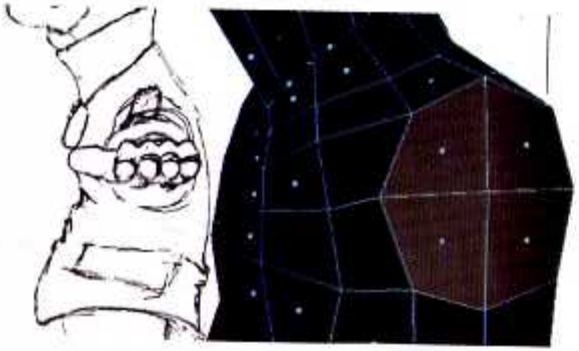
Currently, the arm opening has six bordering edges (or two faces). Ideally, the opening should have eight bordering edges. The torso will thus be split horizontally.

- Use the **Edit Mesh → Insert Edge Loop Tool** to split the torso horizontally.



The faces to be used for extrusion

- Rearrange the vertices to make the arm's faces as round as possible.

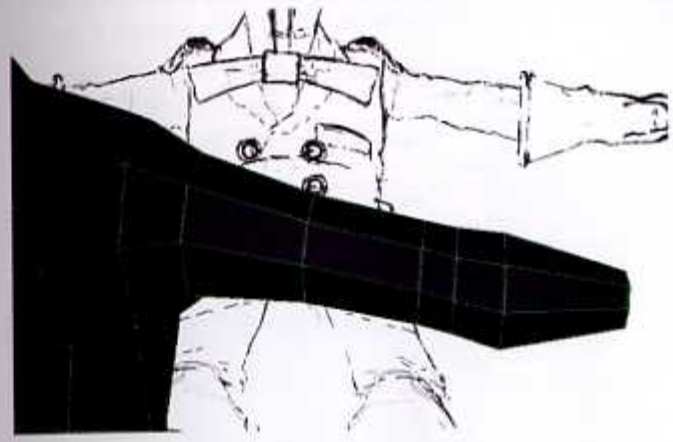


The rounded arm faces

- Select the four arm faces and flatten them on the **X-axis** using the **Scale Tool**.

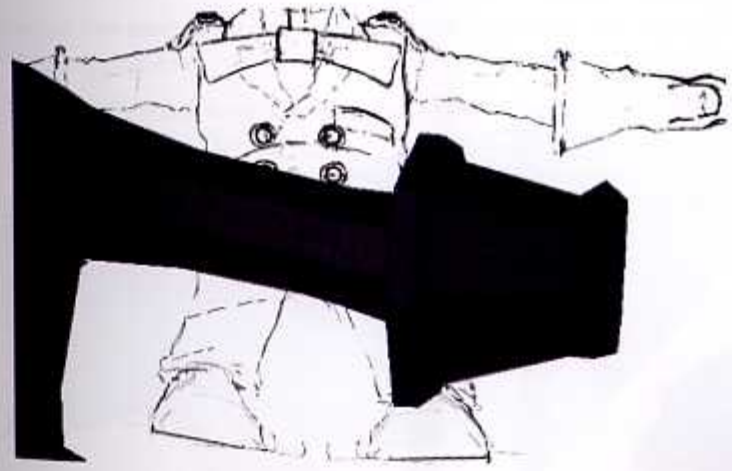
2 Extrude the arm

- **Extrude** the faces out **six** times to the following locations: shoulder, mid-upper arm, before the elbow, middle of elbow, after the elbow, and middle of forearm inside the glove. Use the different manipulators to adjust the arm as you go.



Extruding the arm

- **Extrude** again **seven** times to create the glove: four times to create the glove border, and three times to create the wrist.
- **Move** vertices to shape the arm as well as possible with the current topology.

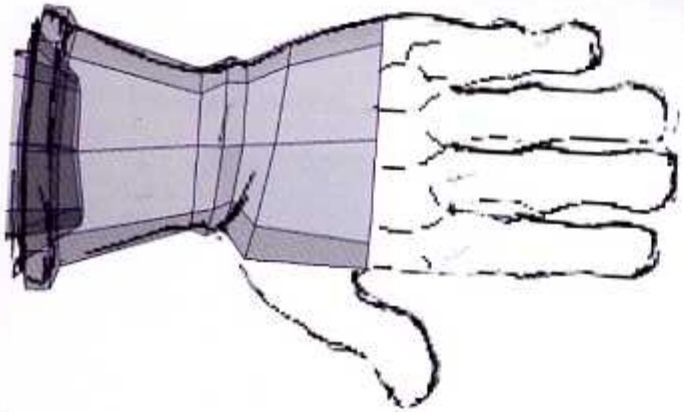


Extruding the glove

3 Extrude the palm

- **Extrude** the faces at the end of the wrist **twice** to create the palm.
- **Move** vertices as needed to shape the hand.

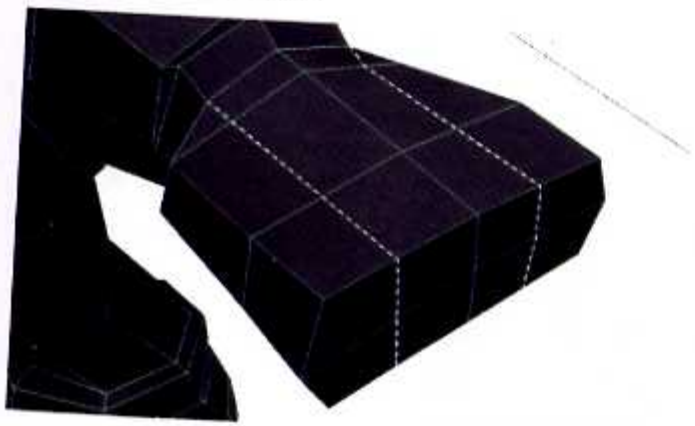
Make sure to place the vertices in a way that will allow you to easily extrude the thumb. The vertex in the center of the palm can be pulled up slightly.



Extrude the palm

4 Extrude the fingers

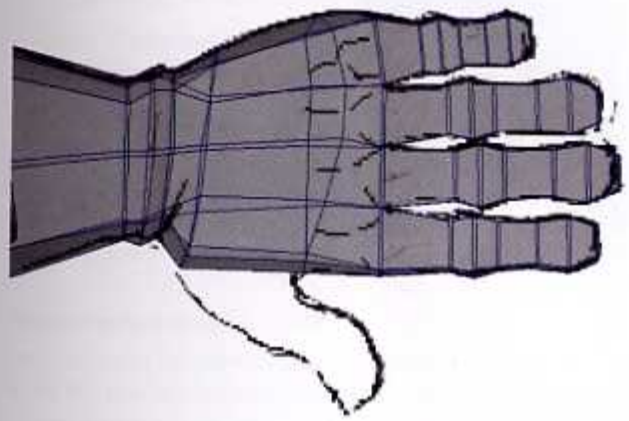
- **Extrude** the faces at the end of the palm one more time to create the knuckles.
- **Split** the faces at the end of the hand to create the four sets of two faces each that will be used to extrude fingers.



Split for the fingers

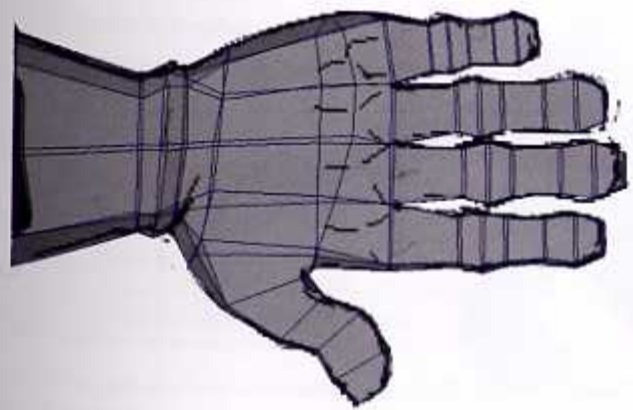
Tip: *When using the* **Split Polygon Tool**, *you can select points that are not necessarily part of the same face. Maya will use the current view to determine the path to take to split across the determined points.*

- **Move** the row of vertices in the middle of the palm slightly forwards to bulge out the flesh at the base of the fingers.
- **Tweak** the vertices so the faces to be used to extract the fingers are flat on their X-axes and equally proportionate.
- **Extrude** each finger **six** times.
- **Move** the vertices for each finger as you are extruding to shape them properly.



The extruded fingers

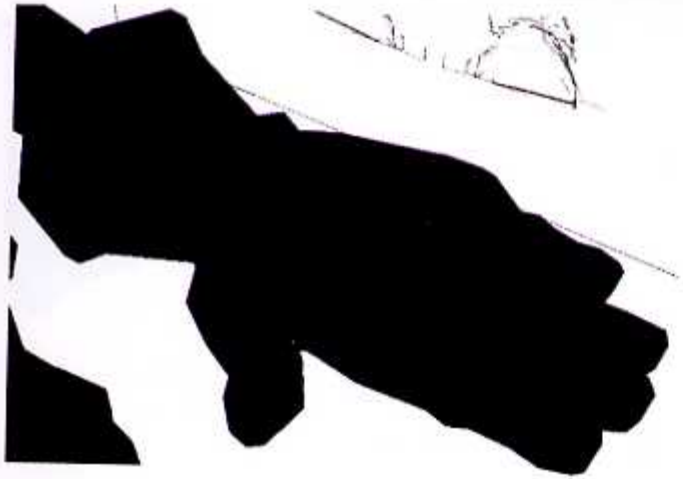
- Select the thumb faces, **extrude** them out **five** times, and **move** the vertices to shape the thumb properly.



The extruded thumb

5 Refine the hand shape

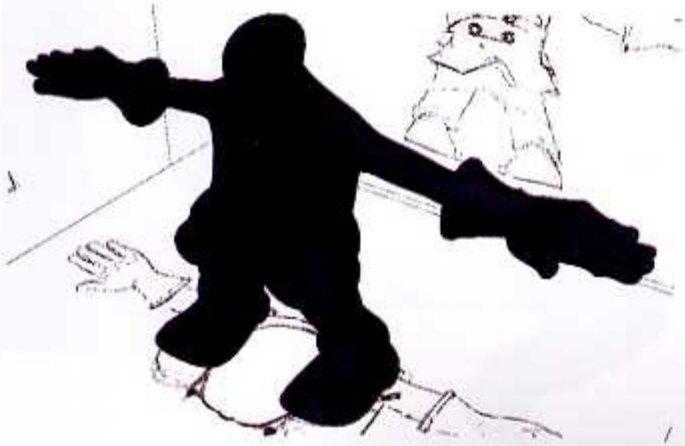
Continue to split edge loops and move vertices on the hand until you are satisfied with the amount of detail. Concentrate on defining the overall structure of the hand and then refine areas such as the knuckles and articulations. Satisfactory results can be achieved with at least six edges to round up the fingers. You may need to delete some existing edges in order to maintain clean topological flow.



The refined hand

6 Preview the high resolution geometry

- With the body geometry selected, press **3** on your keyboard to display the Smooth Preview of the geometry and see how the high resolution model will look.
- Bring any necessary changes before going on.



The Smooth Preview

7 Save your work

- **Save** your work as *02-body_06.ma*.

Refine the entire model

The body has been built with some degree of refinement. At this stage, the topology needs to be assessed and decisions need to be made about how to tie things together. The limbs could be integrated better to enhance the flow of the topology.

You will notice the model has triangles and n-sided faces in several areas. Triangles can cause problems when deforming surfaces. Folds or spikes may appear in areas where you do not want them. Ideally, the model should follow a few rules:

- Quads should be used as much as possible, especially in areas of high deformation.
- Areas of deformation, such as muscles and articulations, should be isolated and defined using loops of edges.
- Loops of edges going through the entire character should be used to tie the model together where you can.

The current character is skinny, wearing clothes with lots of wrinkles, and looking cartoonish, so it is not critical to refine the muscle mass. For other types of characters, it is recommended to spend some time to define the muscles, bones, and articulations.

1 Find irregular polygons

Your geometry has been modeled and shaped to define the overall contour. This is a good start. You now need to assess problematic topology.

- Press **F11** to display polygonal faces on your model.
- Choose **Select → Select Using Constraints...**
- Set the following:

  Constraint to **Next Selection**;

  Order to **N-sided**;
- **Click+drag** in the viewport to select all the faces in your model.

  If you have polygonal faces with more than four sides, they will be selected. If you don't have any irregular polygons, nothing will be selected.
- **Locate** the areas with n-sided polygons and **correct** the problem as needed.

> **Note:** *In some cases, you will need to further define an area before cleaning it up. Even though it is always preferable to define quads, sometimes you will have to define triangles where several edges meet.*

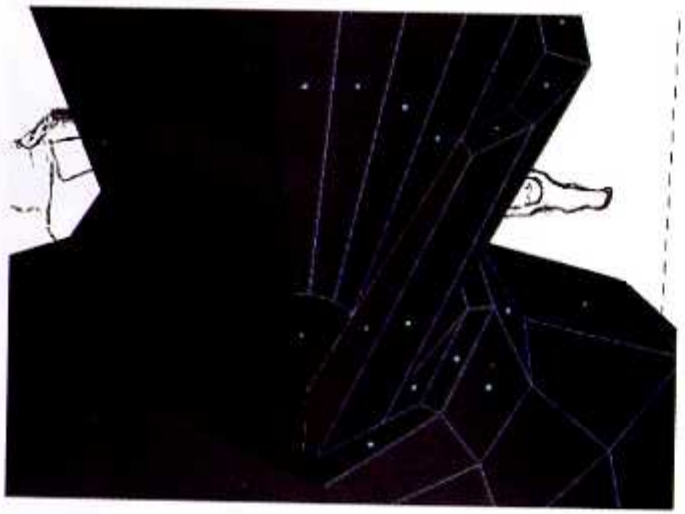
- When you are done with the Selection Constraint window, simply click the **Close and Reset** button.

Tip: *Also try to use the selection constraints to locate triangles and fix them if possible.*

2 Close the collar

Since you have extruded the collar, there has been a hole in the front opening of it. You will now fix this.

- Select any edge on the collar opening.
- **Extrude** the edge, and **move** it so the new face closes the gap in the collar's thickness.
- Select one of the new vertices and hold down the **v** hotkey to snap to point.
- **Click+drag** in the middle of the move manipulator to snap the vertex to another vertex in order to close the collar opening.
- **Repeat** for the other vertex.



The closed collar

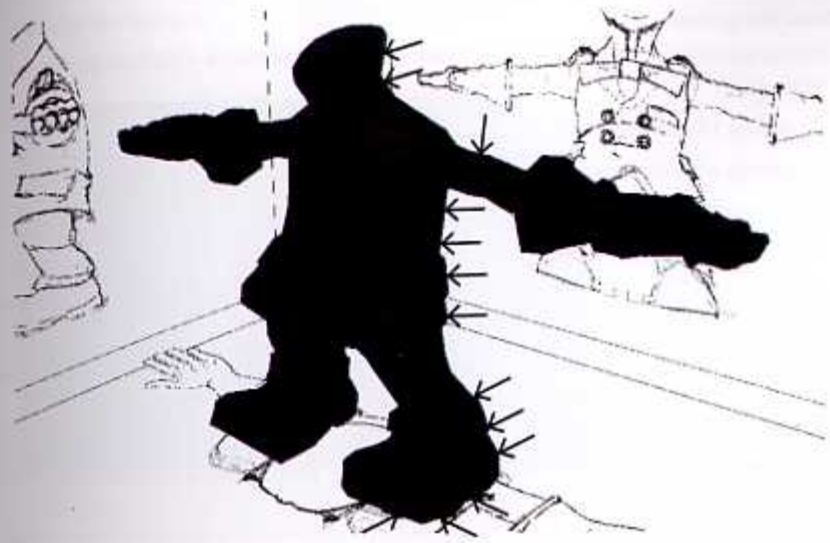
- Select the *body* in Object mode.
- Merge the snapped points by selecting **Edit Mesh → Merge.**

  Doing so will merge the vertices that are snapped together, thus closing the collar surface.

3 Add definition

- Use the **Edit Mesh → Insert Edge Loop Tool** to add definition perpendicular to key deforming areas such as the torso and articulations.

Tip: *Make sure to space out any new edge loops equally. Doing so will greatly improve the model's deformation.*



Inserted edge loops

Tip: *Double-click on an edge to select the entire edge loop in one easy step.*

Mirror geometry

At this point, the body has been symmetrically developed as far as it will be in this lesson. Further changes will be made asymmetrically in the next steps.

1 Delete the instance and the construction history

- Select the right half of the *body* and **delete** it.
- Select **Edit → Delete All by Type → History** to delete all the construction history in the scene.

2 Snap the central vertices

- In the *front* view, select all the vertical central vertices.
- **Double-click** on the **Move Tool** to open its options.
- Make sure the **Retain Component Spacing** option is turned **Off**.
- Still in the front view, hold down **x** to snap to grid and **click+drag** on the **X-axis** in order to snap all the vertices in a perfect vertical line.

  Doing so will close any gaps upon mirroring of the geometry.

Mirror the geometry

- Select the half body, and then select **Mesh → Mirror Geometry →** ❑, and set the following:

  Mirror Direction to **–X**;

  Merge with the original to **On**.

- Click on the **Mirror** button.

  The full body is now a single piece of geometry, and the central vertices were merged. Any further adjustment to the geometry will now have to be reflected on both sides of the model unless you want to break the symmetry of your model.

- With the geometry selected, select **Normals → Soften Edges** to soften any hard edges.

Tip: *In order to confirm that you have closed all the borders (except for the neck opening), you can select* **Display → Polygons → Border Edges** *and look at your geometry in wireframe to reveal thicker border edges.*

Save your work

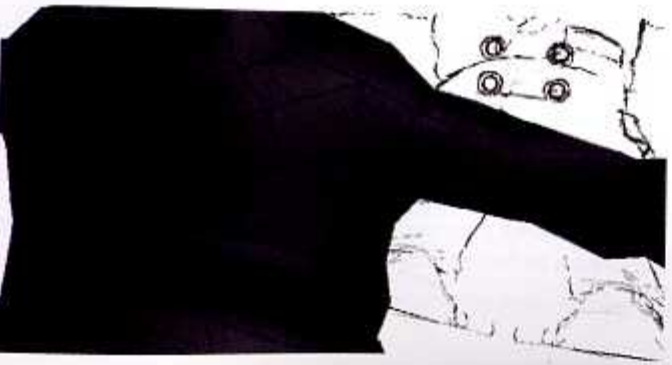
- **Save** your work as *02-body_07.ma*.

symmetric edits

ur character has clothing that should be modeled asymmetrically because of the way the at is buttoned up and the way it stretches. Now that your entire model's body is finished, u can spend some time to model buttons, pockets, and cloth wrinkles. Breaking the nmetry will also considerably increase the realistic look of the model.

Extrude the pocket

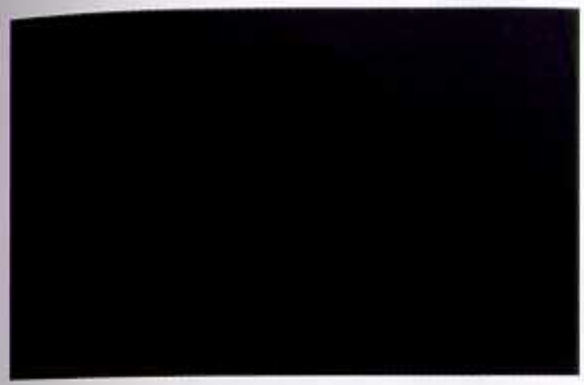
- **Extrude** a patch of faces on the character's coat. Make sure the **Keep Faces Together** option is enabled.



The pocket extrusion

2 Model the buttons

- Using a polygonal cylinder, extrude the front face to model one of the coat buttons.



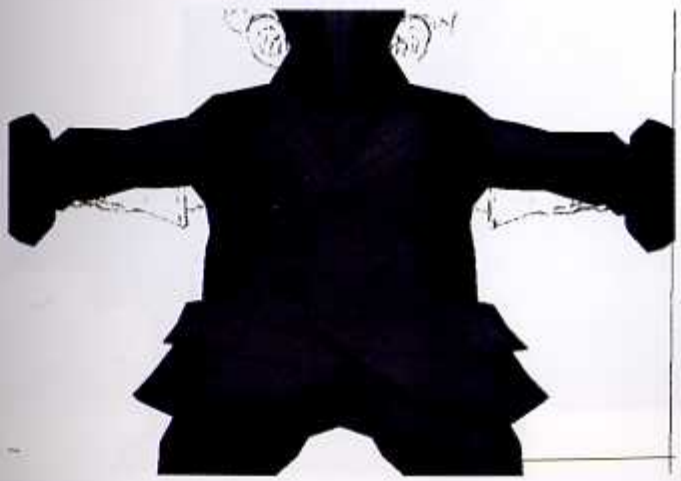
A button

- **Duplicate** the button and place four of them on the coat.

3 Model the coat fold

This step can be quite complicated since it will require you to totally revise the coat's front topology. In this example, only basic explanations will take you through the modeling steps, but you should really take the time to envisage and try to create the coat folds.

- Turn **off** the Move Tool's **Reflection** option.
- **Tweak** the shape of the front of the coat to have a starting point to model the collar and fold of the coat. You should try to get as much as possible using only the current topology without adding any vertices.



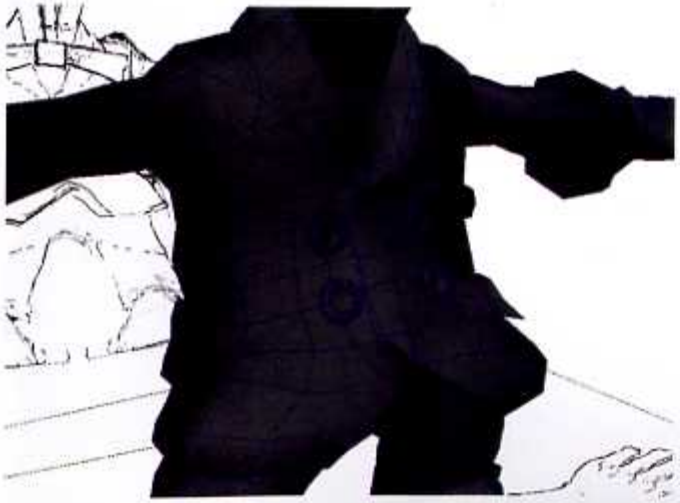
The basic coat fold

- Using the **Split Polygon Tool,** draw directly on the coat to refine the fold topology.

Inserted edges

Tip: *Despite the fact that you are modeling asymmetrically, you should try to make the topology on both sides of the model similar when possible.*

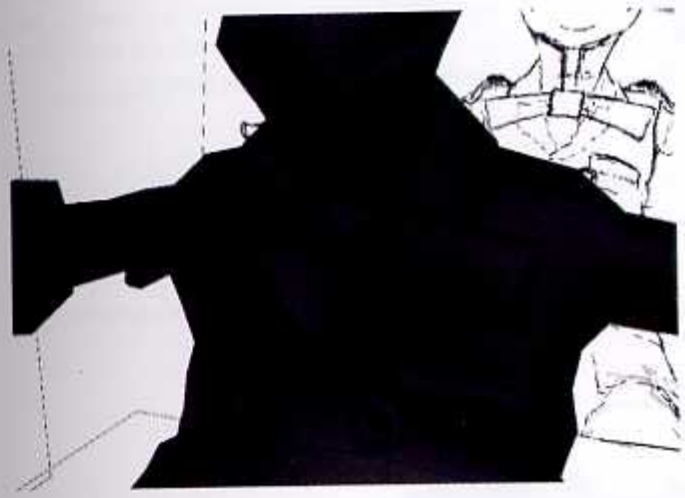
- **Split** the fold line in order to be able to create a border so the fold stands out.



The fold border

4 **Bowtie**

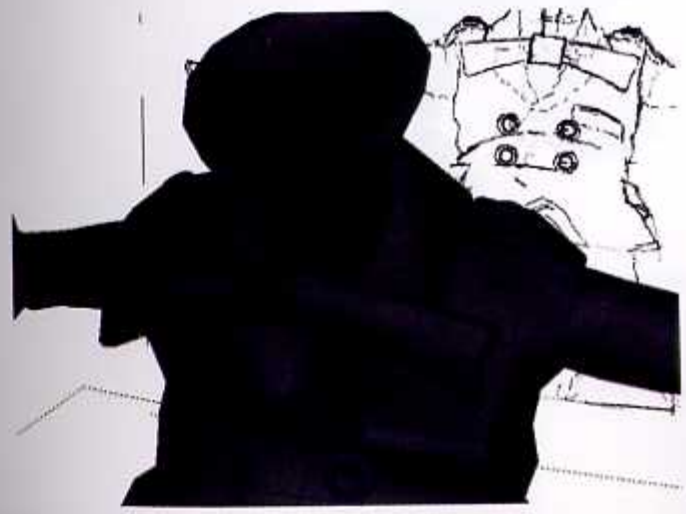
- Starting from a primitive cube, **extrude** a bowtie similar to the one found on the image planes.
- **Bevel** the hard edges to smooth out the resulting geometry.



The bowtie

5 **Epaulettes**

- **Extrude** the faces on the top of the shoulders to create epaulettes.
- **Duplicate** a *button* and place them on the epaulettes.



The epaulettes

6 Belt

- **Extrude** the faces in the back to create a simple belt.

Finalize the Model

1 Sculpt the model

- If needed, use **Mesh → Sculpt Geometry Tool** to sculpt dense geometry.

2 Clean up

- Search for **n-sided** polygons and split them into quads or triangles.
- **Soften** the normals of all edges, unless wanted otherwise.
- If you have snapped vertices together, select **Edit Mesh → Merge**.
- Select **Edit → Delete All by Type → History** to delete all the construction history in the scene.

The Smooth Preview final model

3 Save your work

- **Save** your work as *02-body_08.ma*.

Conclusion

In this lesson, you learned how to model starting from a simple cube to create the Constructor's refined polygon body. Using image planes allowed you to create the body accurately. You learned how to split polygons to create loops of edges that define key areas, as well as how to use extrusions to create limbs. Smooth Preview was used to view the final overall shape of the character.

In the next lesson, you will model the Constructor's head.

Creating a basic polygon head shape

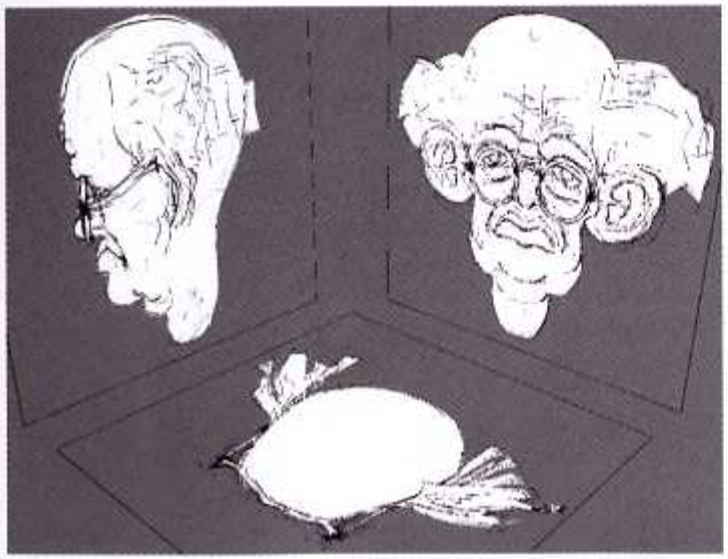
The workflow for modeling a head is very similar to the body; however, the head is a much more complex area and if the proportions and topological flow are not handled correctly, the head will texture and deform improperly.

1 Import image planes

Using the same image plane technique used in the previous lesson, you will now add three image planes for the head using the images *headFront.tif*, *headSide.tif*, and *headTop.tif*.

- Select in any viewport **Panels → Saved Layouts → Four View.**
- If you moved any camera, you can reset its position by selecting **View → Default Home.**
- In the front viewport, select **View → Image Plane → Import Image...**

  This brings up a file browser that allows you to select the required image plane.
- Select *headFront.tif* from the *sourceimages* directory.
- Adjust the image plane **center** attributes as needed to align it properly above the grid.
- Import and place the remaining head image planes.



The image planes

Note: *Based on the concept images, it would be easier to start modeling the head using a polygonal sphere, but since this lesson is about how to generate geometry, you will start from a cube. Note that a sphere would also have lots of triangles in the poles.*

2 Create a cube

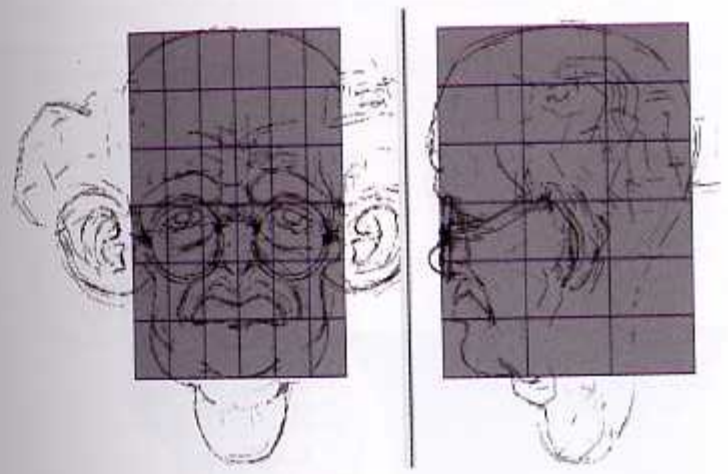
- A polygon cube will be used initially to create the overall shape of the head. Select **Create → Polygon Primitives → Cube → ❑**, and set the following:

  Width divisions to **6**;

  Height divisions to **6**;

  Depth divisions to **3**.

  Notice that those numbers of subdivisions were determined by the different facial parts such as the eyes, nose, mouth, and large forehead. The width divisions also took into consideration the need for a central line of edges. If you desire, you can create a default cube, scale it roughly around the head, and then change those attributes in the Channel Box to best suit the reference images.
- **Scale** the head so it fits around the bounding area of the head, based on the image planes.

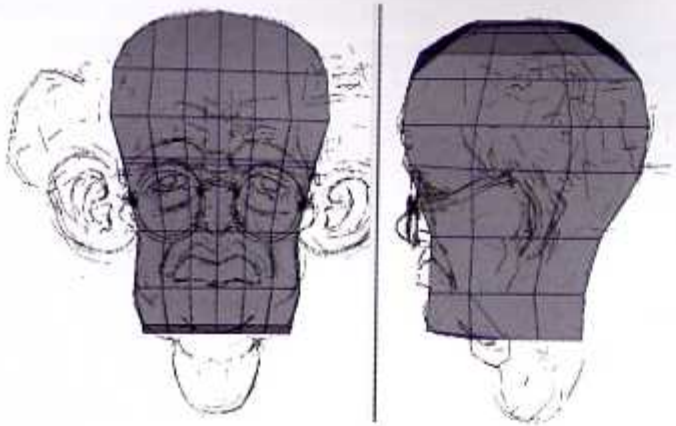


The initial cube

- **Rename** the cube *head*.

3 Work on the basic shape

- **Move** and **scale** vertices in the different views to round off the square edges and define the head shape more accurately. Try to keep your changes symmetrical even though the reference images are not.

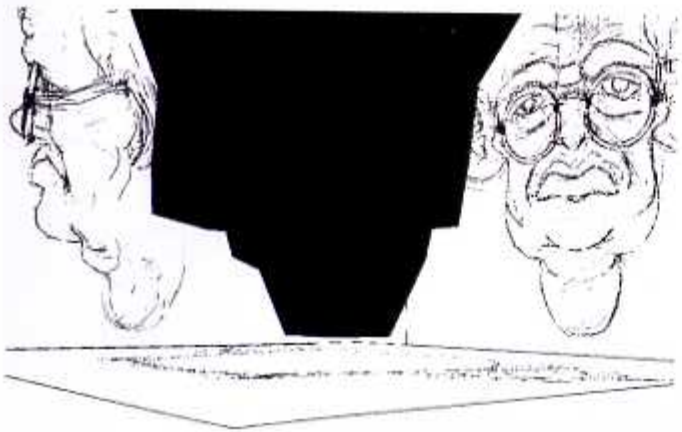


Basic head shape

> **Tip:** *Remember to avoid moving the central vertices of the head away from the center line in the front view to prevent a gap from being created between the object and the mirrored instance.*

4 Extrude the neck

- Select the eight faces forming the neck base and **extrude** them **twice** using **Edit Mesh → Extrude**.



Neck extrusion

- **Delete** the faces under the last neck extrusion since this is where the neck will be connected to the body.

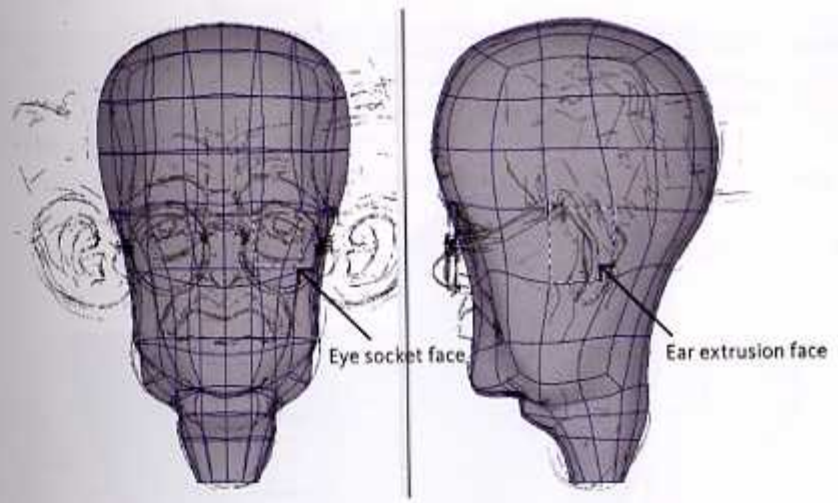
5 Smooth Preview

The Smooth Preview lets you display polygonal surfaces with either or both the proxy polygonal cage and the smoothed high resolution object. By using this feature, you can refine the shape of the low resolution object while seeing the results on the high resolution object, allowing you to get the best final result possible. Once you are done modeling in this mode, you can keep the low resolution object for skinning and texturing, and then smooth it before rendering to get the optimal results.

- With the *head* selected, press the **2** or **3** hotkey to display the Smooth Preview.

6 Refine the head

- **Enable** the Move Tool's **Reflection** option.
- **Refine** the head as much as possible with the current topology.
- Do not forget to round up the initial cube in every viewport.
- Try to delimit the eye socket and ear base with single faces to facilitate their extrusions.



The refined head shape

7 Save your work

- **Save** your scene as *03-head_01.ma*.

Facial details

Now that the basic shape of the head has been achieved, you can work on adding details and correcting the general flow of edges.

1 Mirror instance

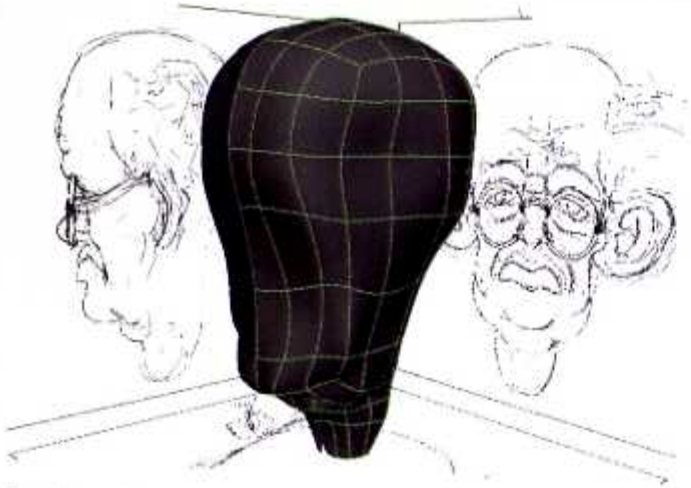
- **Delete** the faces on the right side of the face.
- With the *head* selected, select **Edit → Duplicate Special →** ❑.
- Set the following in the option window:

  Geometry Type to **Instance**;

  Scale X to **-1**.
- Click the **Duplicate Special** button.

The duplicated instance now completes the head, allowing you to do topological changes on both sides at the same time.

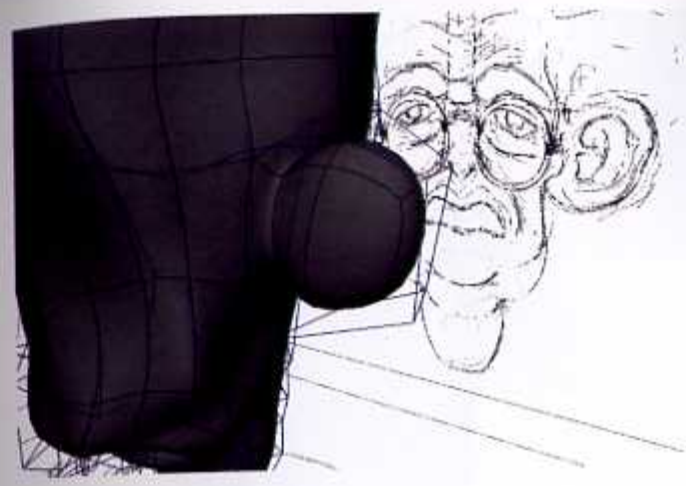
Note: *When using the Smooth Preview with a model divided in half, inappropriate border connections will be made. This can be safely disregarded since the borders will be correct once the model is merged into one piece.*



The mirrored instance with Smooth Preview

2 Extrude the ear

- Select the face at the base of the ear and **extrude** it **three** times.



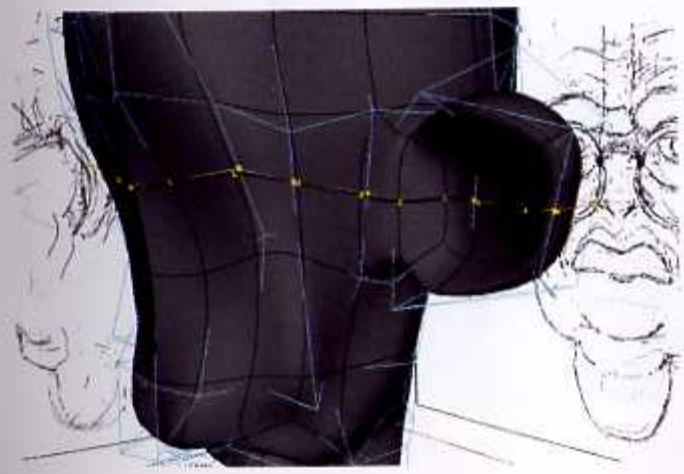
The ear extrusion

- **Extrude** the two front faces to be used to create the inside of the ear again.
- **Tweak** the ear as much as you can.

3 Add edges

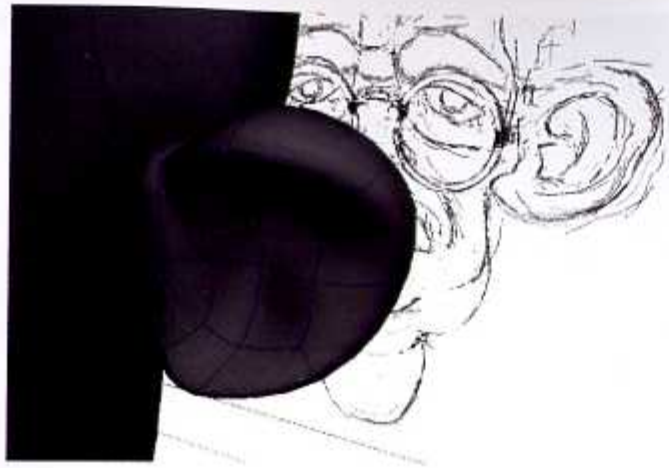
Now that you are running out of vertices to refine the ear, it is time to add some edge loops to your model.

- Select **Edit Mesh → Insert Edge Loop Tool** and add a horizontal edge loop that splits the ear and the eye socket area in half.



The new edge loop

- **Refine** the head using the new components.

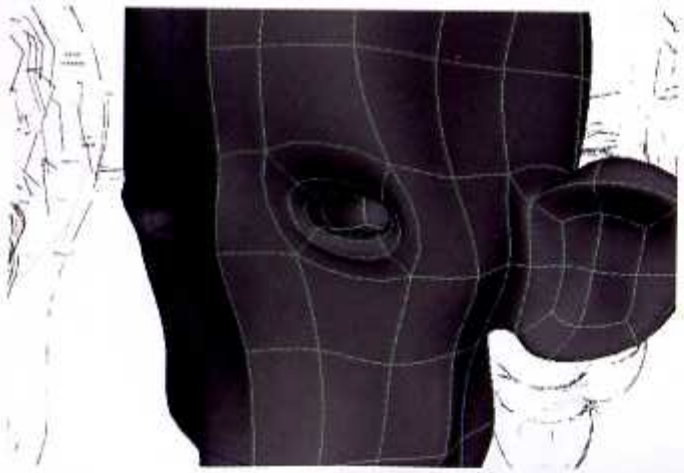


The refined ear

4 Eye socket

In order for the eye socket to be round, you will require at least eight vertices to shape it. You will now extrude the eye socket and then add subdivisions to the head.

- **Extrude** the face, delimiting the eye **four** times; first, to create the eyelids, then for thickness to the eyelid, then for inside the eyelid, and finally, to create the eye socket inside the head.



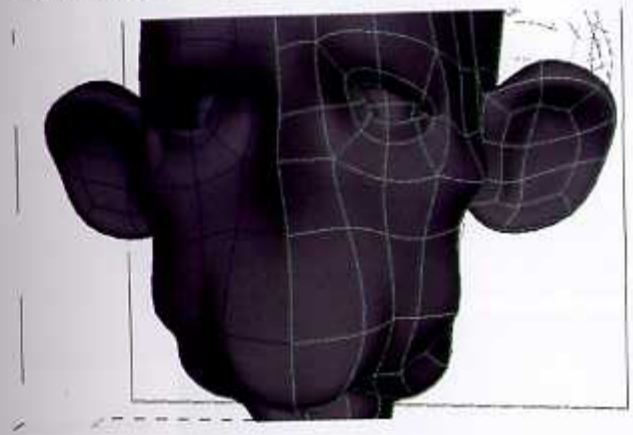
The extruded eye socket

- Insert **two** edge loops, one running vertically and one horizontally in the eye socket.
- **Refine** the new topology around the eyes.

5 Shape the head

The inserted edge loops also split faces all around the head. Now is a good time to revise the topology of the head.

- **Refine** the global shape of the head.

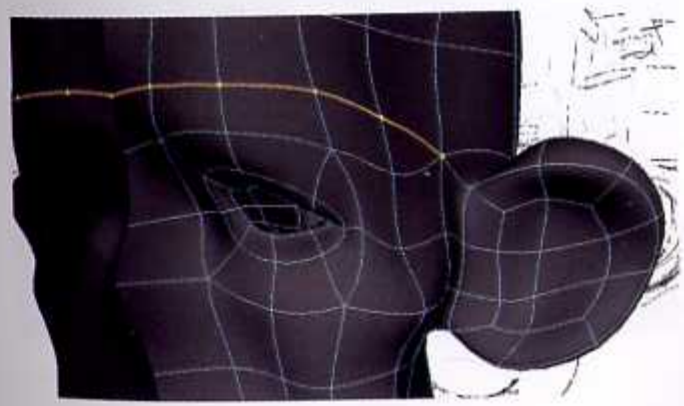


The refined eye socket

> **Tip:** *Make sure to have the edges extend from the eye socket radially. Doing so represents the radial layout of muscles going around the eye.*

6 Brows

- **Split** edges to define the eyebrow as follows:



The eyebrow split

Doing so defines topology that does not go all around the head. The back of the head has more than enough topology at this time.

Note: *When using the Split Polygon Tool on a mesh with Smooth Preview enabled, the proxy cage is displayed so you can choose the edges to split. Press the 1 hotkey to display the original geometry.*

7 Nose

- Select the central faces defining the base of the nose and **extrude** them once.
- Pull them out on the **Z-axis** using global translation.
- Since the extrusion has created unwanted faces on the central line, select them and **delete** them.

  You now have a proper extrusion to be used to model the nose.
- **Refine** the nose shape.

The extruded nose

8 Nose extrusions

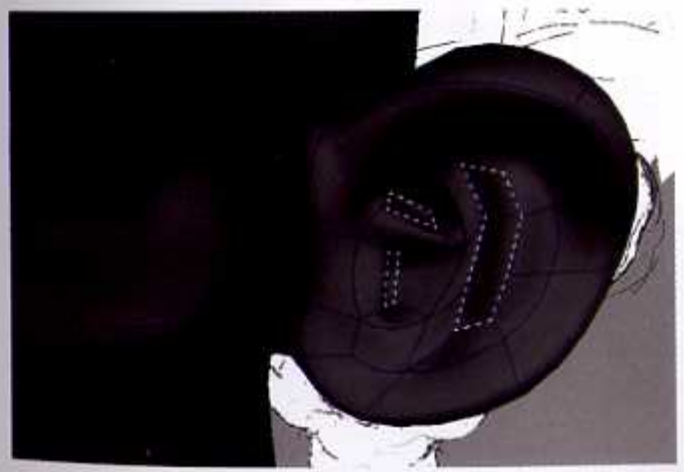
- **Extrude** the nostril bulging out from the side of the nose.
- **Extrude** a hole going toward the inside, under the nostril.
- **Extrude** the tip of the nose bulging out.
- **Extrude** a bump on the nose bulging out.

The nose refinements

9 Ear extrusions

Now that you have more topology in the ear due to the past edge insertions, you can finish the details in the earlobe.

- **Extrude** the hole in the ear.
- **Extrude** more faces to the entire lobe details as follows:



The ear extrusion

10 Save your work

- **Save** your scene as *03-head_02.ma*.

Model the mouth

Perhaps the most difficult facial part to model is the mouth. This is because there are many things to consider at once. First, you need to add lots of topology to be able to model a proper mouth. Second, you need to take into consideration the radial flow of the topology coming from the mouth muscles. Third, you must not clutter the rest of the model with unnecessary edges. Finally, all this topology needs to deform and animate smoothly.

1 Edge loop

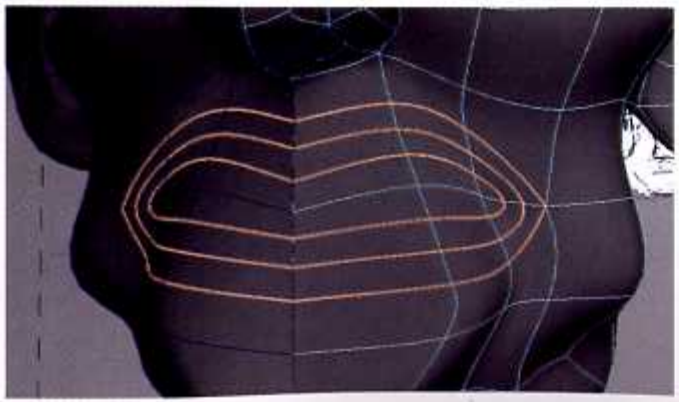
- Use the **Insert Edge Loop Tool** to split the mouth area in two.

The mouth edge loop

2 Adding topology

Since you want to avoid splitting edges all the way to the back of the head, you must concentrate on splitting the mouth region of the model radially.

- **Split** the mouth area as follows:



Splits to refine the mouth

- **Refine** the mouth shape according to the image planes.

The shaped mouth

3 Extrude the mouth

- Select the faces defining the entire mouth.
- Press **Ctrl+»** to increase the selection to choose the next ring of faces under the nose, in the cheek, and in the chin.
- **Extrude** the faces and refine the new vertices to make the old man's crease around the mouth.

  Doing so will give you another edge loop going around the lips, plus a row of vertices under the nose.
- **Scale** the new faces in slightly.

  Doing so will prevent an eventual merge operation that merges vertices from the extrusion on top of each other.
- **Tweak** the geometry to your liking.

> **Note:** *Because the two sides of the head are separate, the geometry on the central axis will not accurately represent the model until you merge them together.*

- Select the following vertices, and then select **Edit Mesh → Merge To Center.**

  Doing so will collapse the two vertices together and correct the flow of edges going around the mouth.

Mouth refinements

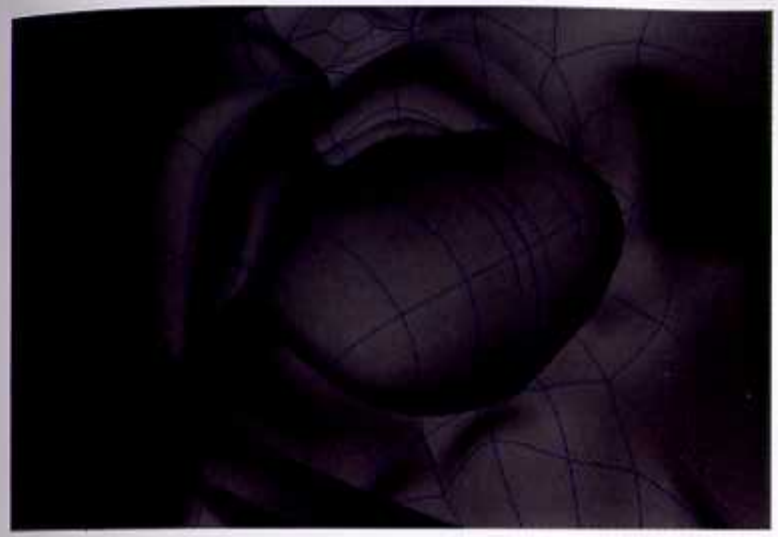
- Continue refining the mouth topology until you are satisfied.

4 The inner mouth

Refining the inner mouth can be quite challenging, since visualizing the 3D surface through a wireframe tangle requires a very good understanding of your geometry. The best way to work on the inner mouth is to reverse the head's normals and hide the backfaces. Doing so will allow you to see the inside of the head.

- Select the *head*, and then select **Normals → Reverse**.
- If the backfaces are visible, hide them by selecting **Display → Polygons → Backface Culling**.
- Select the three edges located exactly where the top and bottom lips meet.
- Select **Edit Mesh → Bevel** to get an extra row of vertices inside the mouth.

  Using a bevel makes it quick and easy to create new faces to extrude. You could also manually split polygons in order to get faces to extrude.
- Select the four new faces and then **Extrude** them toward the inside of the mouth.
- **Extrude** the same faces again to get even more geometry.
- Manually tweak the new vertices to create the inner mouth as follows:



The inner mouth

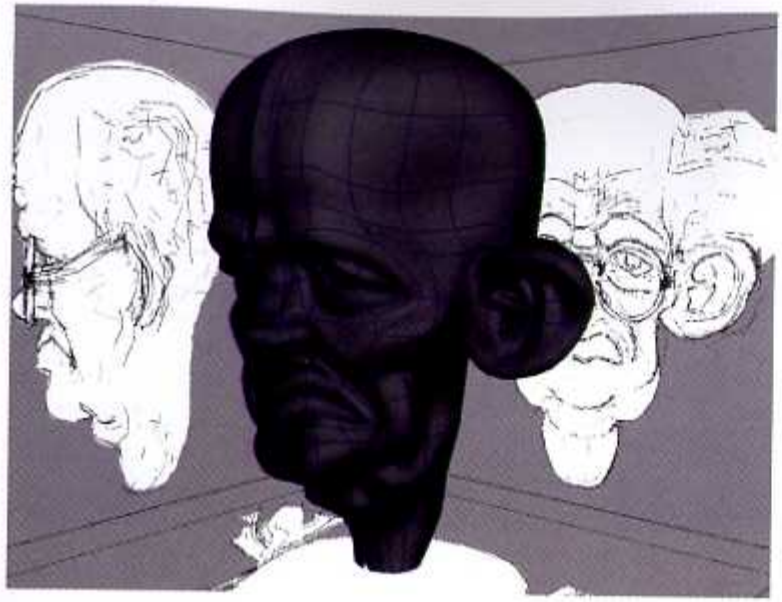
> **Tip:** *Be careful not to select the vertices in the corner of the mouth, otherwise you will deform the mouth. Depending on how big you make the inner mouth, the tension between the vertices might slightly open the mouth. Make sure to leave a gap between the upper and lower lips. This will prevent merging problems and will greatly help when deforming the lips.*

- When you are done, select the *head* and toggle **Normals → Reverse** and **Display → Polygons → Backface Culling**.

5 Refine the head

Now that you have finished the basic model, you can start to add details to the head.

- Take some time to adjust the whole mouth to match the image planes.
- The structure of the head is done; however, undesirable topology exists in several areas. Triangles and five-sided faces are evident in areas where they should not exist. Selection constraints can be used to help you identify the problematic areas. Spend time tweaking the current topology as best you can.



The final topology

> **Note:** *At this stage in the process, it is becoming very difficult to add topology since any change will have a domino effect through the entire model. This is an expected part of the modeling process that will allow you to improve visualizing modeling approaches.*

6 Save your scene

- **Save** your scene as *03-head_03.ma*.

The eyes

Now you will add separate spheres to create the eyes and tweak the eyelids to curve on the surface correctly.

1 Eyeball

- Select **Create → NURBS Primitives → Sphere**.
- **Rename** the sphere to *eyeball*.
- **Move** the *eyeball* to its correct location.
- **Rotate** the *eyeball* by **90** degrees on the **X-axis**.
- **Scale** the *eyeball* appropriately.

The eyeball in place

> **Tip:** *The eyeball should always be perfectly round.*

2 Duplicate the eye

- With the *eyeball* selected, select **Edit → Group.**
- Select **Edit → Duplicate Special** and set the following:

  Geometry type to **Copy**;

  Scale X to **−1**.

- Click the **Duplicate Special** button.

  Since the group's pivot was placed at the origin with default options, when you duplicate it with an inverse scale, the result is a mirrored version of the eyeball.

3 Reference layer

- **Assign** both *eyeballs* to a new layer and set the layer to be a **Reference** layer.

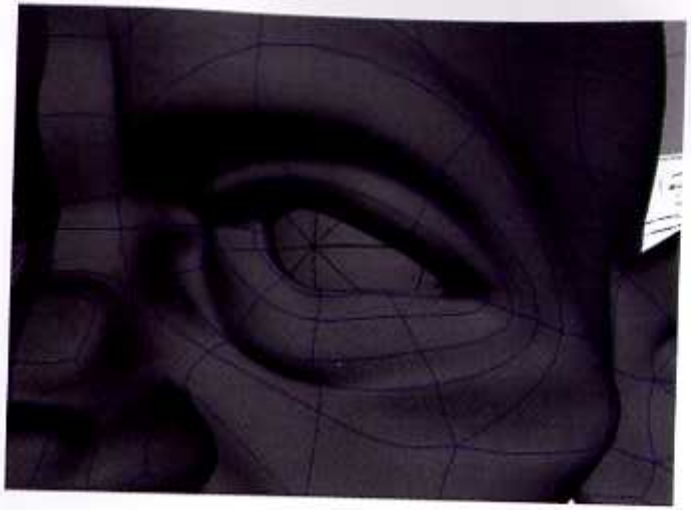
  This will allow you to work on the eyelid without accidentally selecting and moving the eyeballs. You will notice that the eyelid requires adjustment in order to follow the eyeball's curve correctly.

4 Tweak the eyelids

- **Move** the eyelid vertices to properly follow the *eyeball* surface.

  The inner eyelid edge loop should be barely visible going through the eyeball.

- Use the **Split Polygon Tool** to add edges around the eye socket.
- Round up the eyelid and adjust the surrounding vertices.



The refined eyelid

5 Clean up

- Delete the instanced head surface.
- Make sure all the central vertices are snapped onto the X-axis.
- With the *head* selected, select **Mesh → Mirror Geometry**.
- With the *head* selected, select **Normals → Soften Edge**.
- Select **Edit → Delete All by Type → History**.

6 Save your work

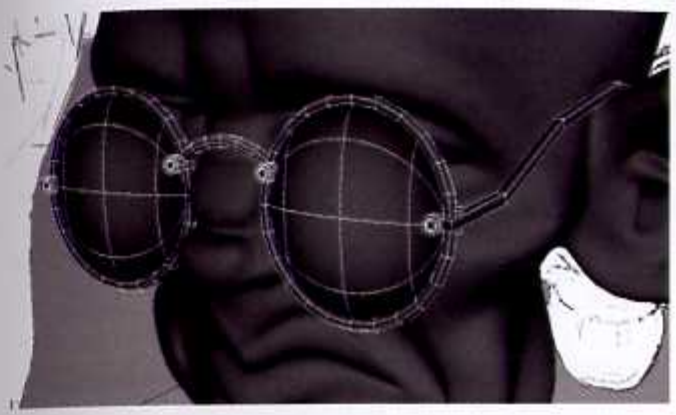
- **Save** your scene as *03-head_04.ma*.

Head details

Since you could continue to improve your head indefinitely, you need at some point to call the geometry final. You will now stop improving the head's topology and concentrate on adding the final details.

1 Glasses

The glasses can be created from multiple primitives. Model only one half of the glasses and mirror it once done. In this example, the glass frame was modeled from polygonal primitives and the lens was made from flattened NURBS spheres.



The glasses

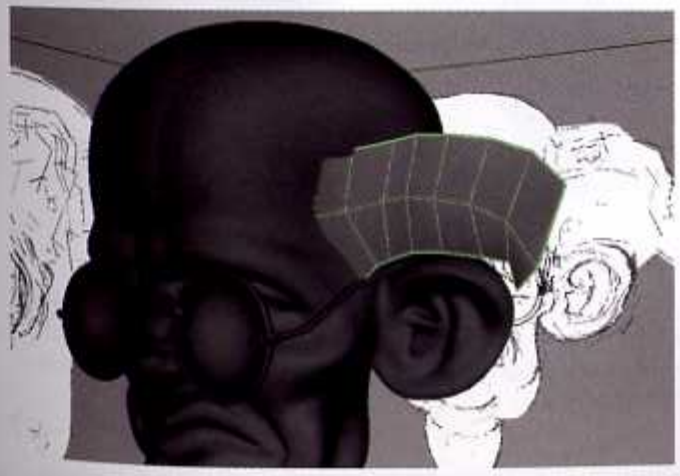
- Select all the glasses' polygonal objects and then select **Mesh → Combine**.

Note: *The lens will be made semi-transparent in the next lesson.*

2 Hair

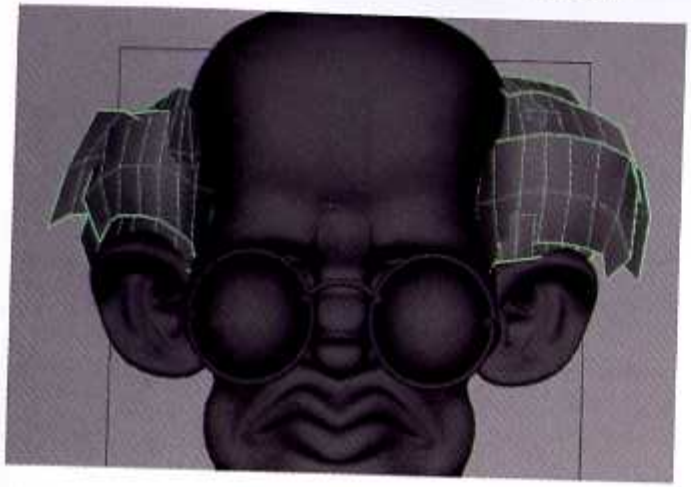
You will now create the hair. In order to simplify that process, you will create a bunch of planes on which a hair texture with transparency will be applied in the next lesson.

- **Create** a polygonal plane with **7 Subdivisions Width** and **2 Subdivisions Height.**
- **Tweak** the plane so it represents a part of the bangs coming out from the side of the head.



One part of the bangs

- **Duplicate** the bangs part and create a few more coming out from above the ear.
- **Mirror** the hair bangs to the other side of the head.
- **Tweak** the new hair bangs so they are not symmetrical.
- Select all the hair bangs and then select **Mesh → Combine**.



The hair in place

3 Clean up

- **Rename** all the objects properly.
- With the *hair* and *glassesFrame* selected, select **Normals → Soften Edge**.
- Select **Edit → Delete All by Type → History**.
- **RMB** on the *layer1* used to reference the eyes, and then select **Delete Layer**.
- Open the **Outliner** and **delete** any unwanted nodes, if any.

4 Save your work

- **Save** your scene as *03-head_05.ma*.

Combining the body and the head

The Constructor's body and head can now be combined. This is an easy procedure since the head and body do not need to be attached together. If the head was attached to the body, the same number of edges on the neck opening would be required for the head and the body.

1 Group the head

- Since you will have to move the head to fit the body geometry, select all the head geometry and **group** it.

2 Delete the image planes

The image planes are no longer needed.

- Open **Window → Rendering Editors → Hypershade**.
- In the top part of the Hypershade, select the **Cameras** tab.
- Select the three image planes and **delete** them.

3 Import the body

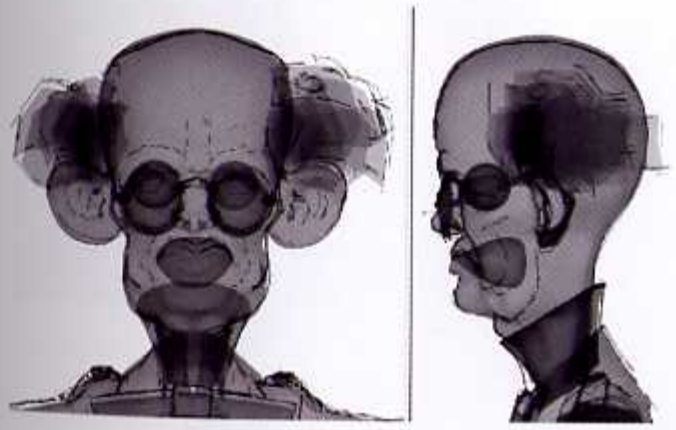
- Select **File → Import → ❑**.
- In the options window, set the following:

  Use namespaces to **Off**.

  Resolve **Clashing nodes** with **the filename**.
- Click the **Import** button and select the scene file called *02-body_08.ma*.

4 Place the head

- Select the group containing all the head geometry.
- **Scale** and **move** the *head* until it matches the image planes.



The body with the head aligned

5 Neck

Make sure the neck fits properly in the body's collar opening. Make sure the different surfaces are far enough from each other so they do not interpenetrate when deforming.

6 Finalize the model

- Use the **Edit Polygons → Sculpt Polygon Tool** to sculpt the model if wanted.

Tip: *You can sculpt equally on both sides of the head by turning on the Reflection option (reflecting against the X-axis), in the Stroke section. Also, you can select vertices on which you want to paint. Lastly, you can click the Flood button to smooth the selection all at once.*

- Do finishing tweaks to the model before calling it final.

7 Crease Tool

The Crease Tool allows you to tweak the components of the Smooth Preview model. This means that you can select vertices or edges and crease them to your liking. The following shows how to crease the coat fold so it stays sharp even when smoothed.

- **RMB** on the coat and select **Edge**.
- **Double-click** on the edge loop in the coat fold to select it.
- Make sure to look at the model in Smooth Preview mode by pressing **3**.
- Select **Edit Mesh → Crease Tool.**
- **MMB+drag** in the viewport to change the creasing of the selected edges.

  Creased edges are displayed with thicker component lines.
- Continue creasing any edges you would like.

Some creased edges

8 Clean up

- Select all geometry pieces, and **group** them under a single group named *geometry*.
- Select all geometry pieces, and then select **Modify → Freeze Transformations**.
- Select **Edit → Delete All by Type → History**.
- **Delete** any obsolete nodes in the **Outliner**.
- **Delete** the image planes from the **Hypershade.**
- Select **File → Optimize Scene Size** to clean up the scene.

The completed character

9 Save your work

- **Save** your scene as *03-constructor_01.ma*

Conclusion

Congratulations–you have now modeled an entire character! In the process, you learned how to model using several polygonal tools. You also learned where to split edges to create edge loops around key areas of the face. Doing so greatly helps when it comes time to deform the model.

In the next lesson, you will texture the character using several polygonal texturing tools.