



CS475/CS675 Computer Graphics

Principles of Animation

Animation

- The term animation has a Greek (*animos*) as well as Roman (*anima*) root, meaning “to bring to life.”



Ratatouille, Pixar Animation Studios, 2007.



Spirited Away, Studio Ghibli, 2001.

Animation

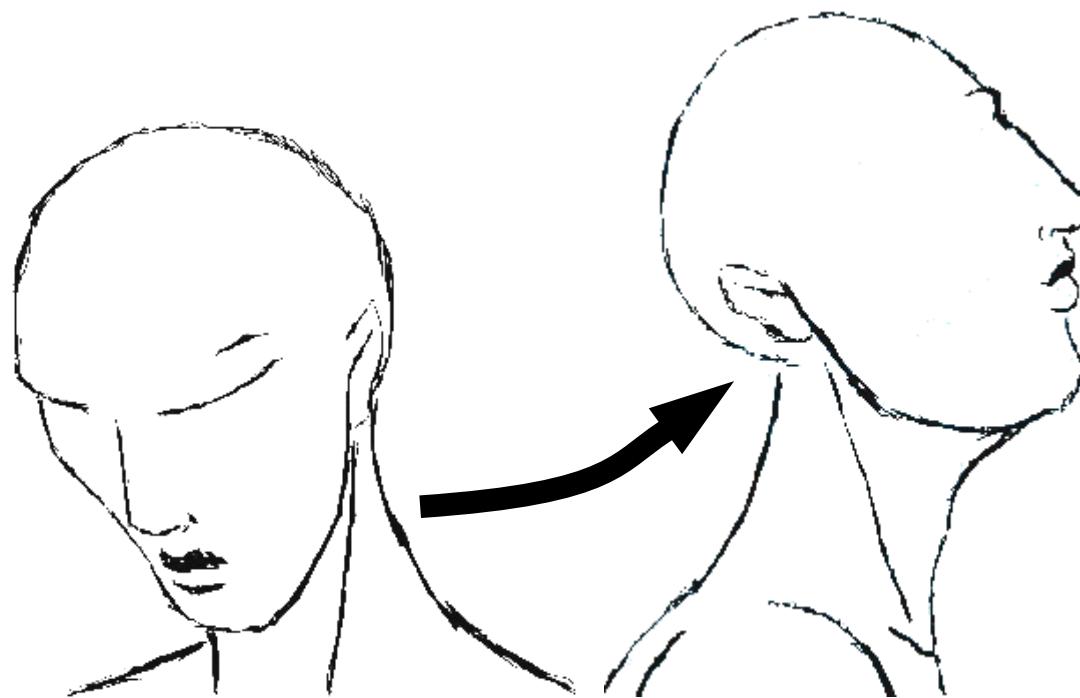
- Series of pictures of objects/characters in motion
- Displayed at some rate
 - 25 fps, 29.97 fps, 30 fps, 60fps
- Examples
 - Flip Books
 - Stop Motion (Claymation)
 - Traditional Hand Drawn Animation (Cel Animation)
 - Computer-assisted Keyframing
 - Motion Capture
 - Simulation

Animation

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Character Animation

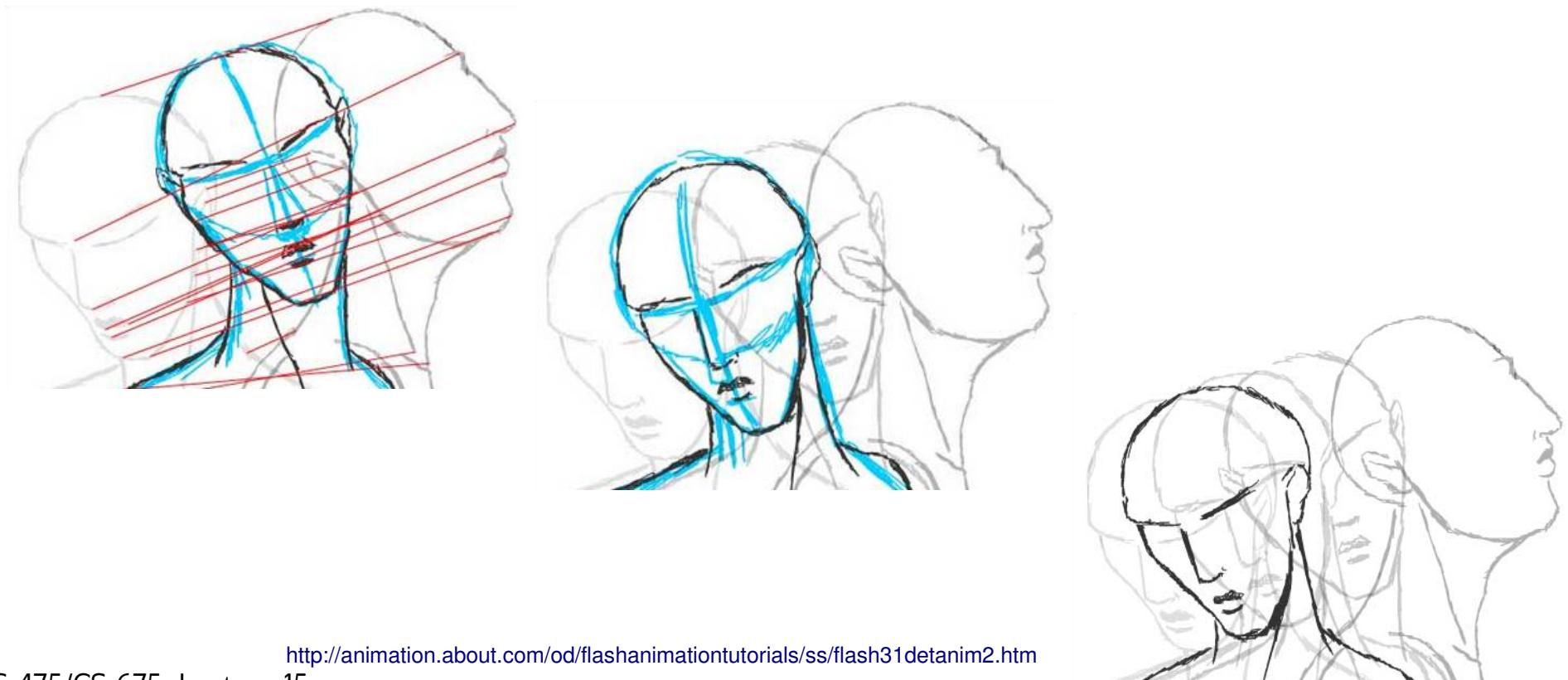
- Traditional
 - Cell Animation, hand drawn, 2D
 - Lead Animator for keyframes



<http://animation.about.com/od/flashanimationtutorials/ss/flash31detanim2.htm>

Character Animation

- Traditional, hand drawn animation
 - Lead Animator for keyframes and many secondary animators for the in-betweens



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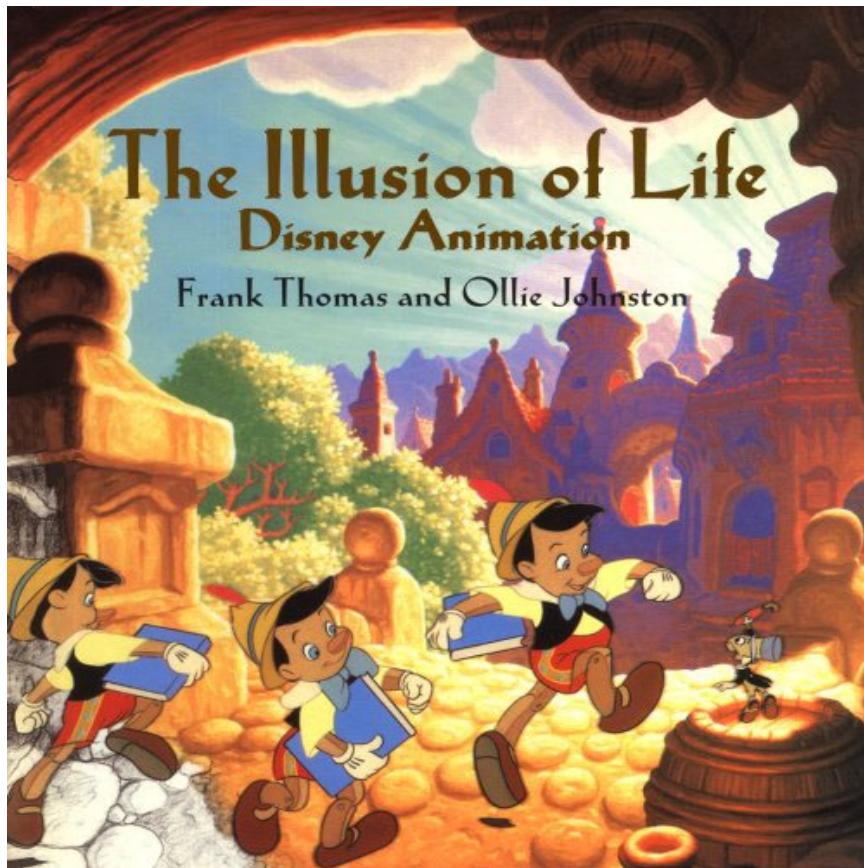
Character Animation

- Traditional, hand drawn animation
 - *Keyframing @24fps – how many drawings for a 2 hour movie?*



<http://animation.about.com/od/flashanimationtutorials/ss/flash31detanim2.htm>

Principles of Animation

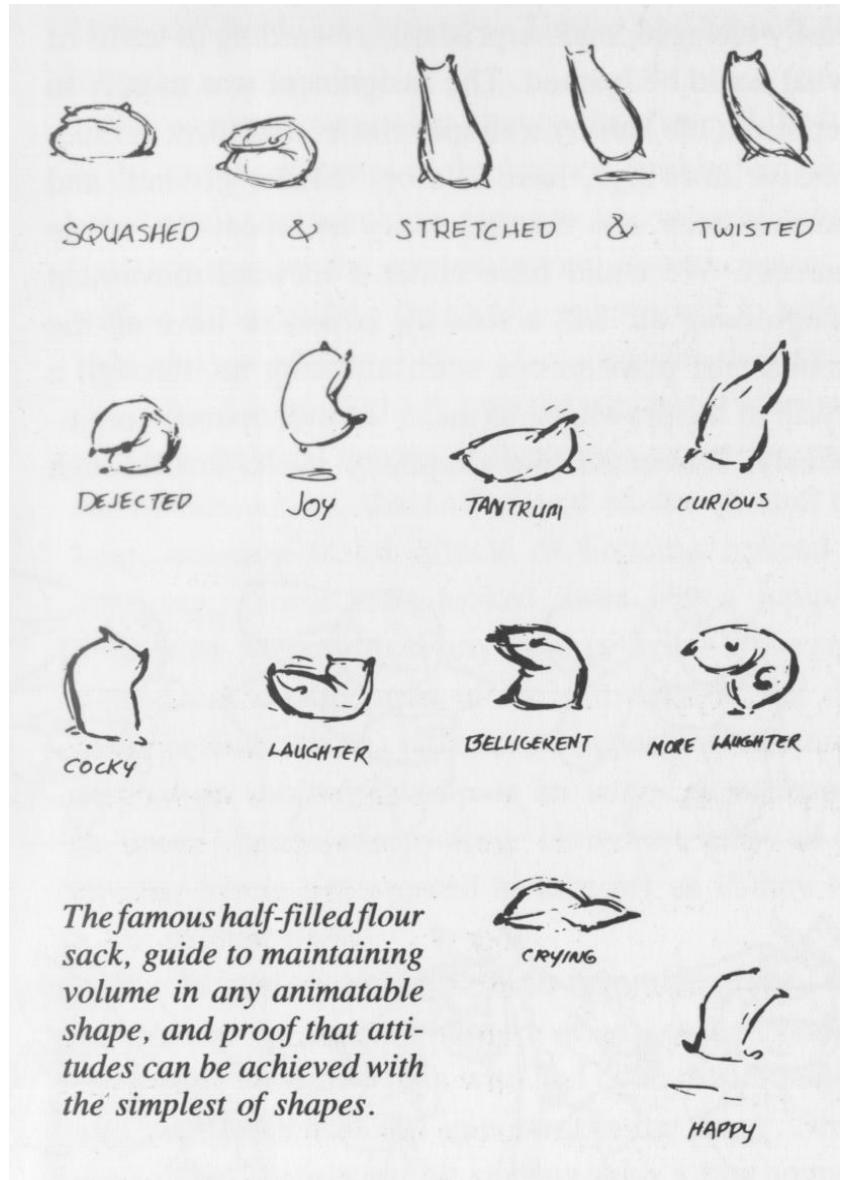


"Illusion Of Life" by Frank Thomas & Ollie Johnston, Hyperion Press, (ISBN 0-7868-6070-7), 1981.

- Principles of Traditional Animation Applied to 3D Computer Animation, John Lasseter, SIGGRAPH 1997.

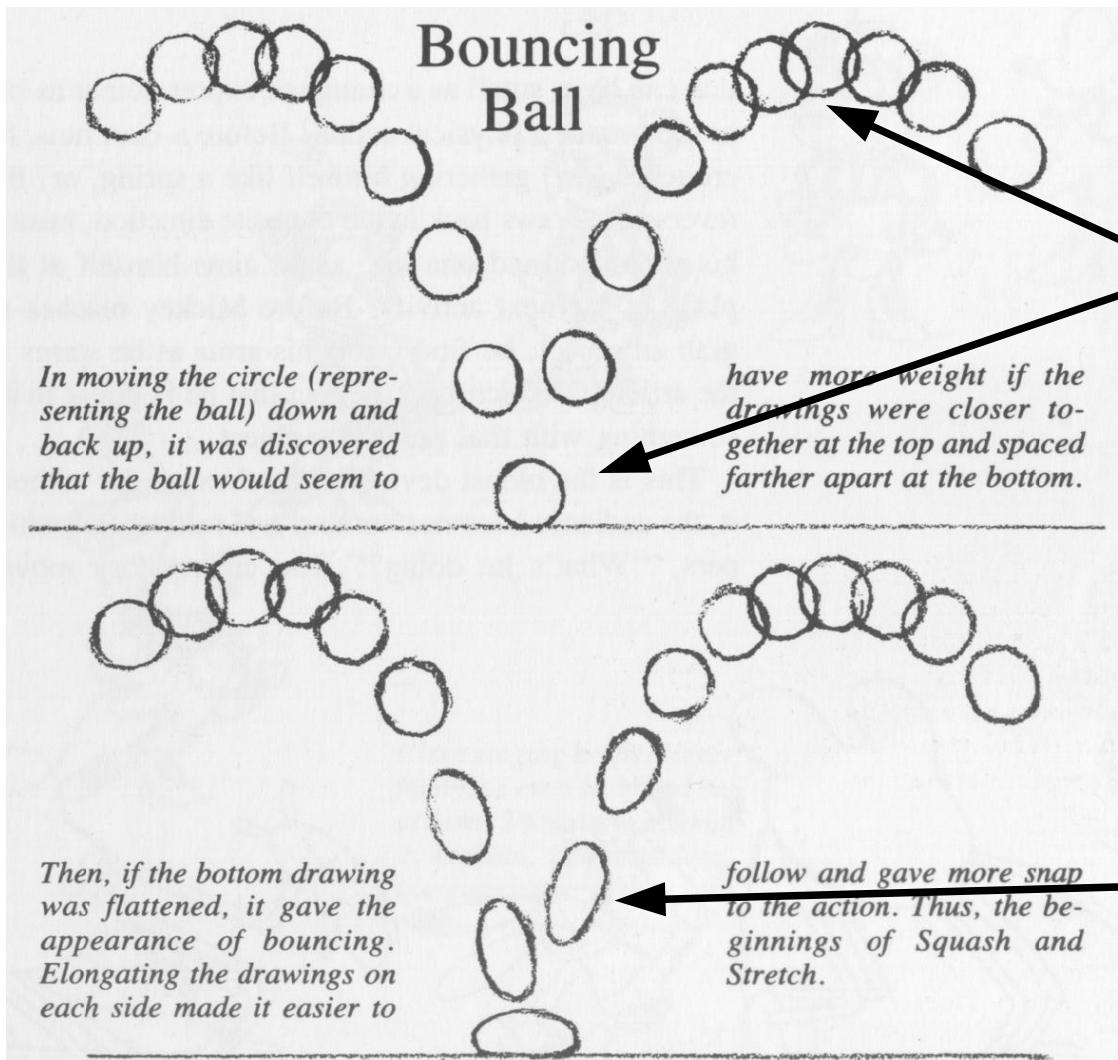
Principles of Animation

- Characters composed of living flesh do not move rigidly (muscle flex, skin sags, etc.)
- Preservation of volume is key
- Disney animators demonstrate it here with a half-filled bag of flour.



"Illusion Of Life" by Frank Thomas & Ollie Johnston, Hyperion Press, (ISBN 0-7868-6070-7), 1981.
CS 475/CS 675: Lecture 15

Principles of Animation



- Squash and Stretch

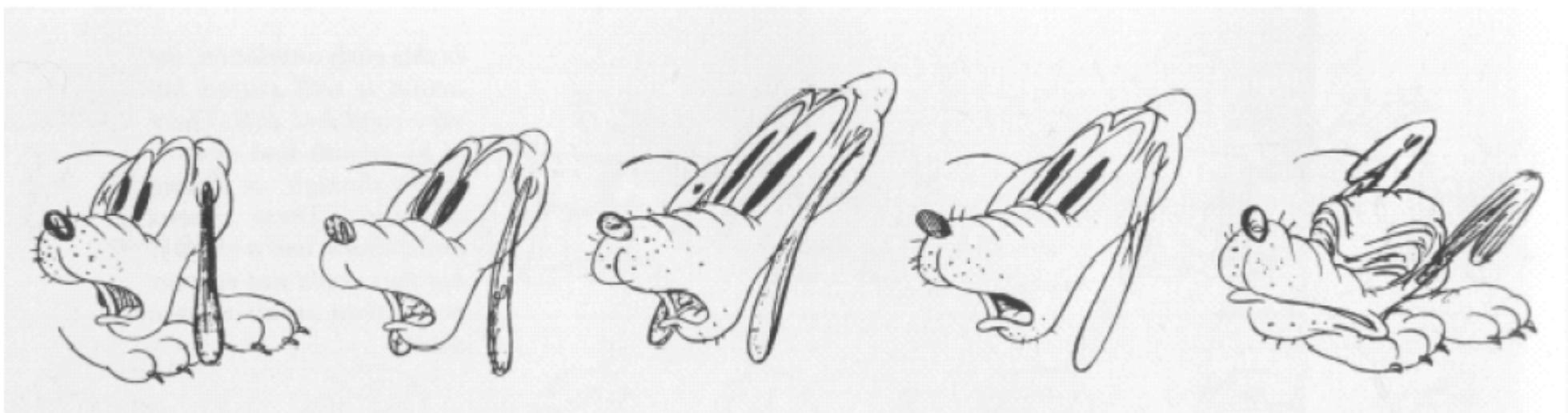
Weight is given to the ball using timing.

Add squash and stretch to further define the motion and show the speed of the ball.

A 2D representation of motion blur

Principles of Animation

- Squash and Stretch



"Illusion Of Life" by Frank Thomas & Ollie Johnston, Hyperion Press, (ISBN 0-7868-6070-7), 1981.

Approximately maintain volume...but drastically change physical characteristics over time

Principles of Animation

- Anticipation



- Tell the audience what you are going to do before you do it.
- Can be as simple as facial expressions or as broad as a body wind-up.
- What is Donald about to do?

Principles of Animation

- Staging

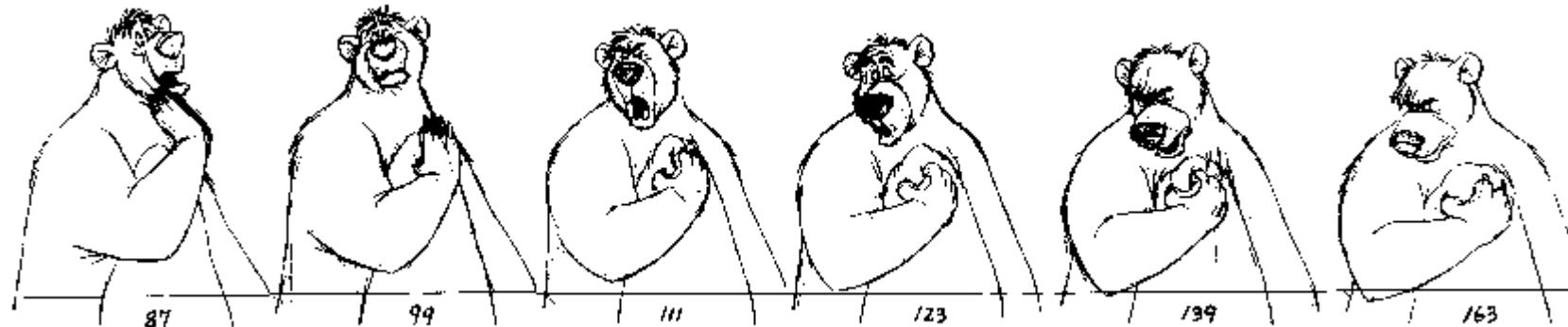


Cartoon Animation, Preston Blair, Walter Foster, 1984

- A principle borrowed from the theatre stage.
- Try to make actions to be clear in silhouette.
- Character posing and placing the camera is the key.

Principles of Animation

- Straight Ahead and Pose to Pose

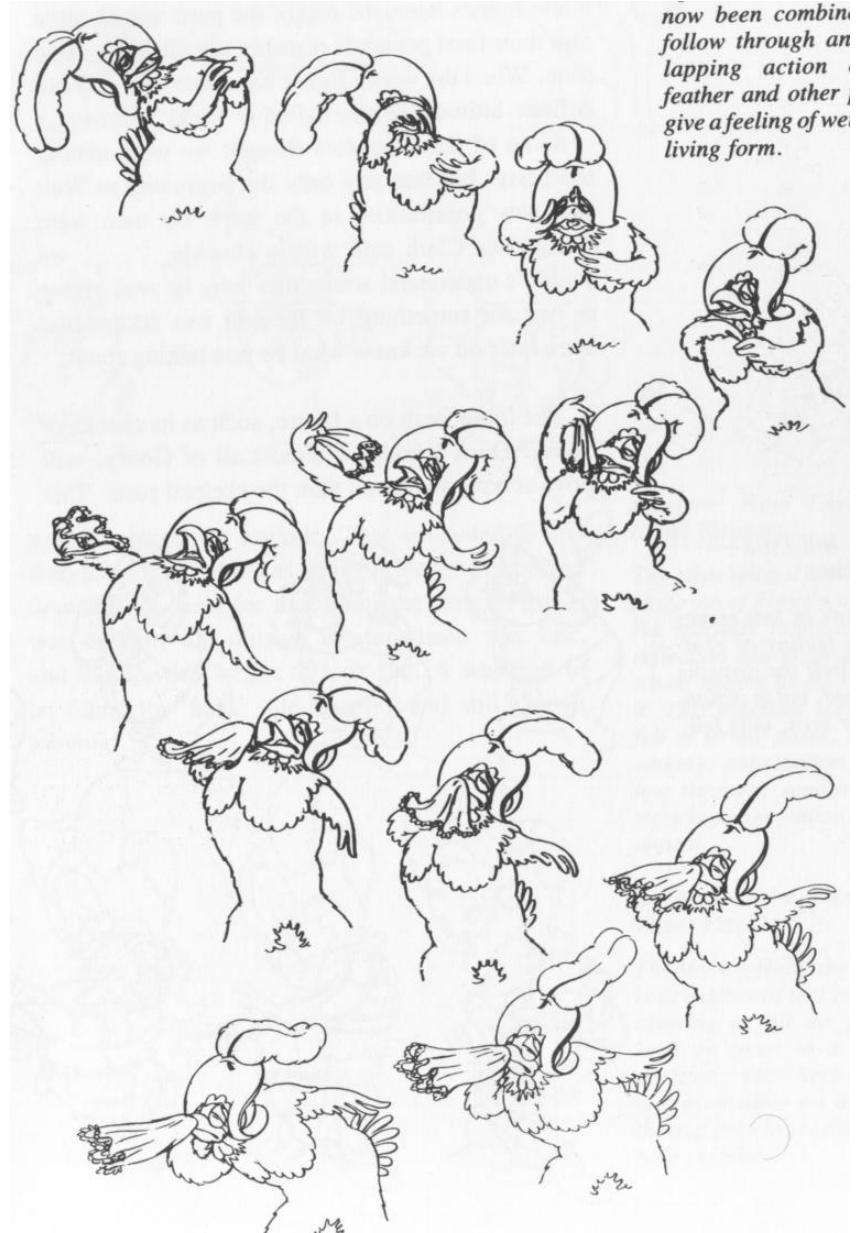


"Illusion Of Life" by Frank Thomas & Ollie Johnston, Hyperion Press, (ISBN 0-7868-6070-7), 1981.

- Two ways to animate a scene.
- Start with an idea in mind and draw all frames until done. Good for frantic motion such as a character jumping around in excitement.
- Draw the key frames first. Fill in the in-betweens.

Principles of Animation

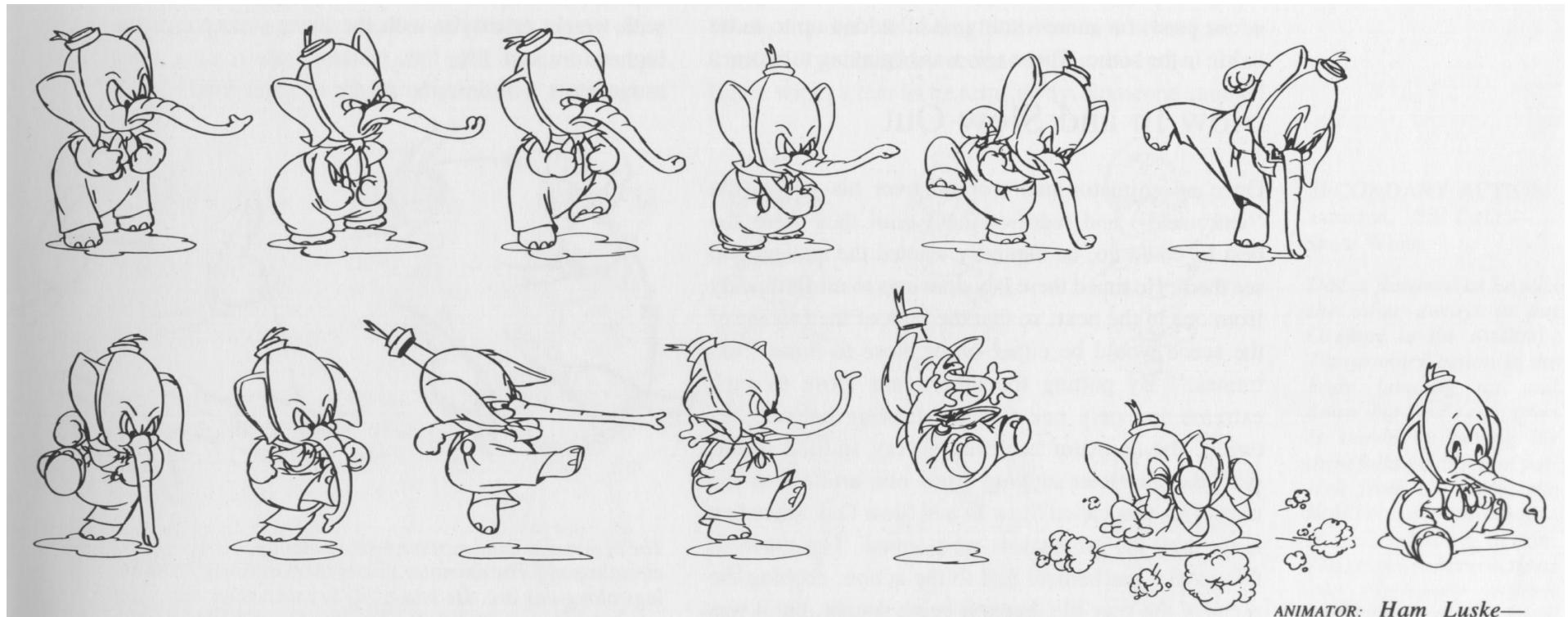
- Follow Through and Overlapping Action
 - Everything does not have to stop once a pose is reached.
 - The way the action is completed tells us a great deal about a character. In some sense this is the opposite of anticipation... tell the audience what happened!



"Illusion Of Life" by Frank Thomas & Ollie Johnston, Hyperion Press, (ISBN 0-7868-6070-7), 1981.

Principles of Animation

- Follow Through and Overlapping Action



"Illusion Of Life" by Frank Thomas & Ollie Johnston, Hyperion Press, (ISBN 0-7868-6070-7), 1981.

ANIMATOR: Ham Luske—

Principles of Animation

- Slow In and Slow Out

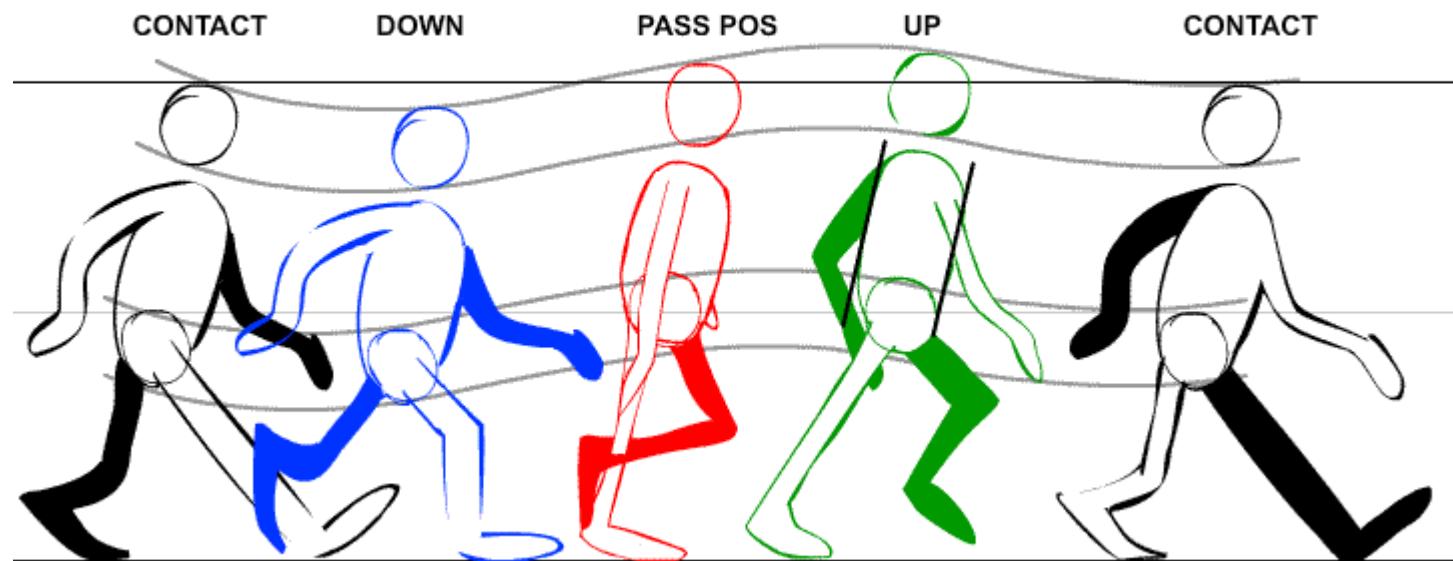
- Animator specifies the primary or key frames which are most important.
- In order to stress these frames, move slowly away from one key frame , quickly in the in-between frames, and slowly into the next frame.
- Most time is spent on/near the key frames.



Principles of Animation

- Arcs

- Motion in straight lines is often not *organic*.
- Most human motion happens on curved trajectories or arcs.

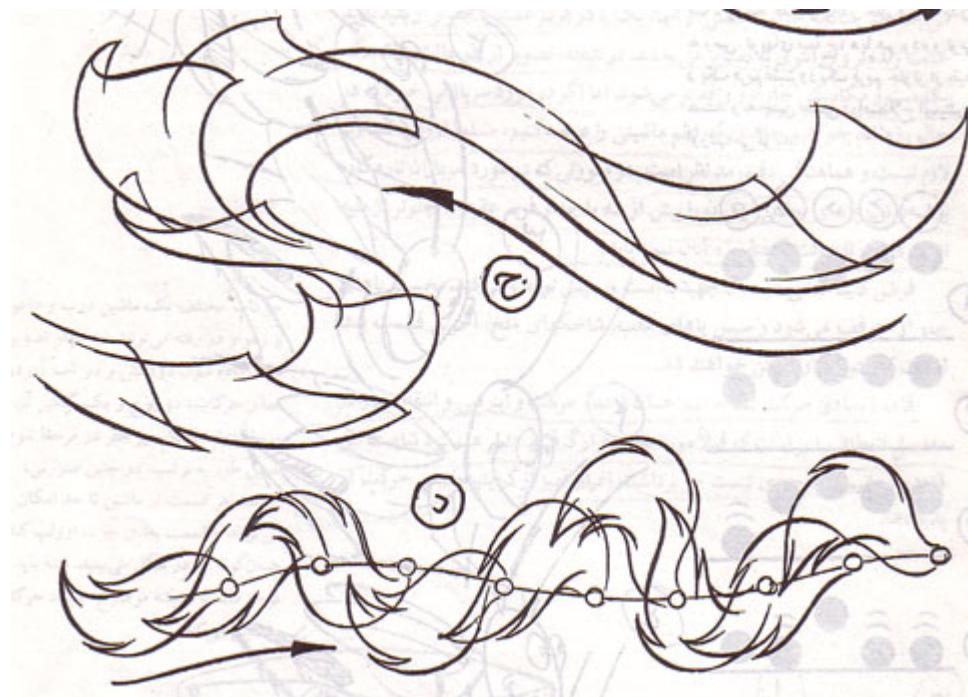


The Animator's Survival Kit, Richard Williams, Faber & Faber, 2002

Principles of Animation

- Arcs

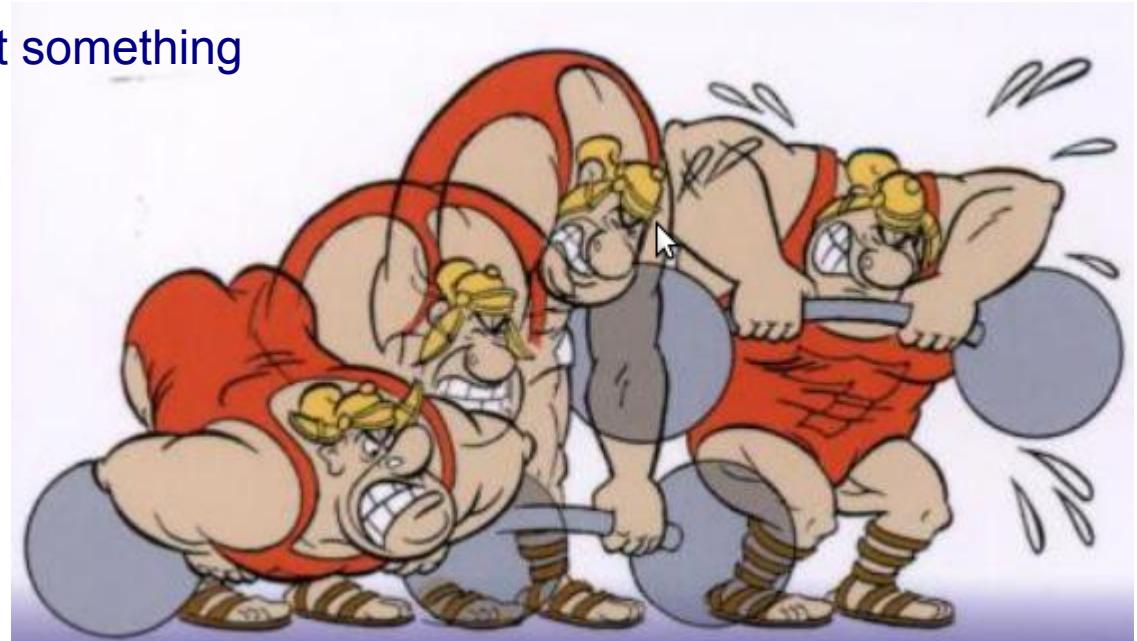
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Cartoon Animation, Preston Blair, Walter Foster, 1984

Principles of Animation

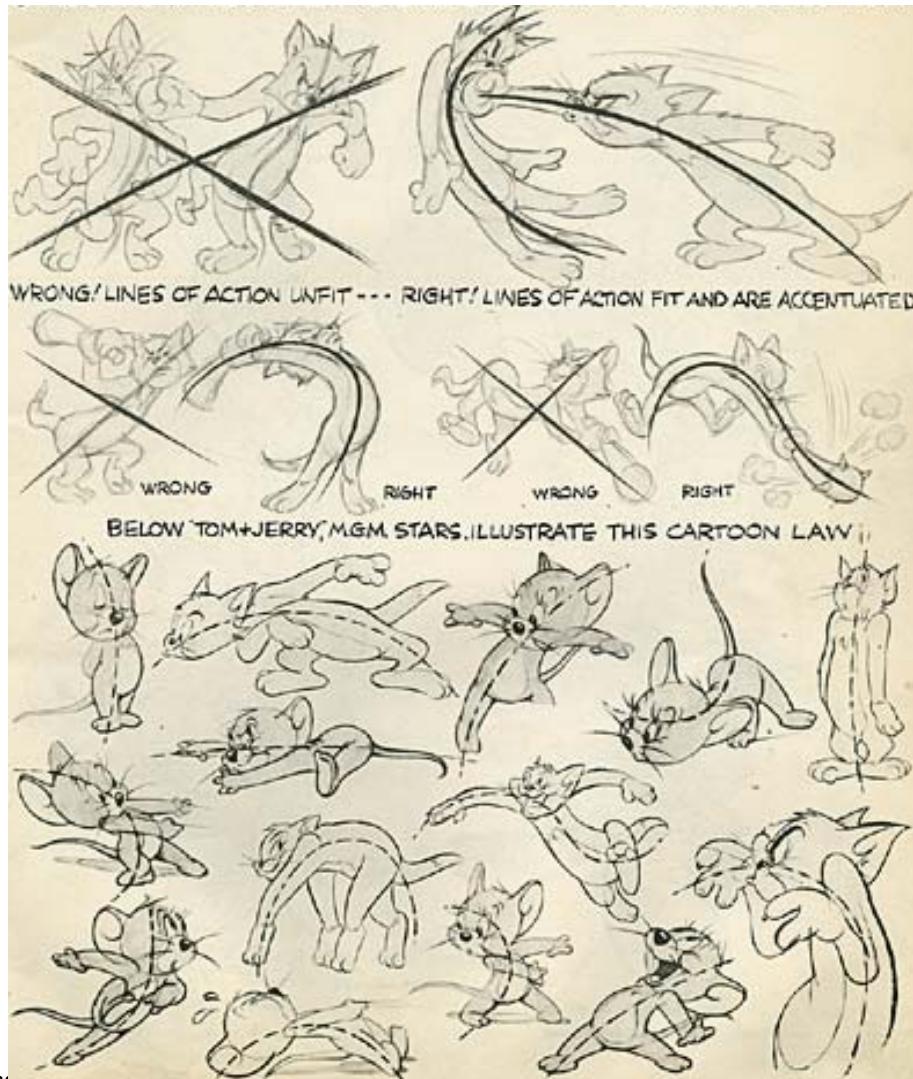
- Timing
- The number of drawings determine the amount of time it takes on the screen
- no in-betweens: character hit with a huge force and his head is nearly snapped off
- two : nervous tic, muscle spasm
- five: Come on...hurry
- seven: tries to get a better look at something
- ten: stretches a sore neck



Timing for animation, Harold Whitaker, John Halas, Focal Press, 2002

Principles of Animation

- Exaggeration

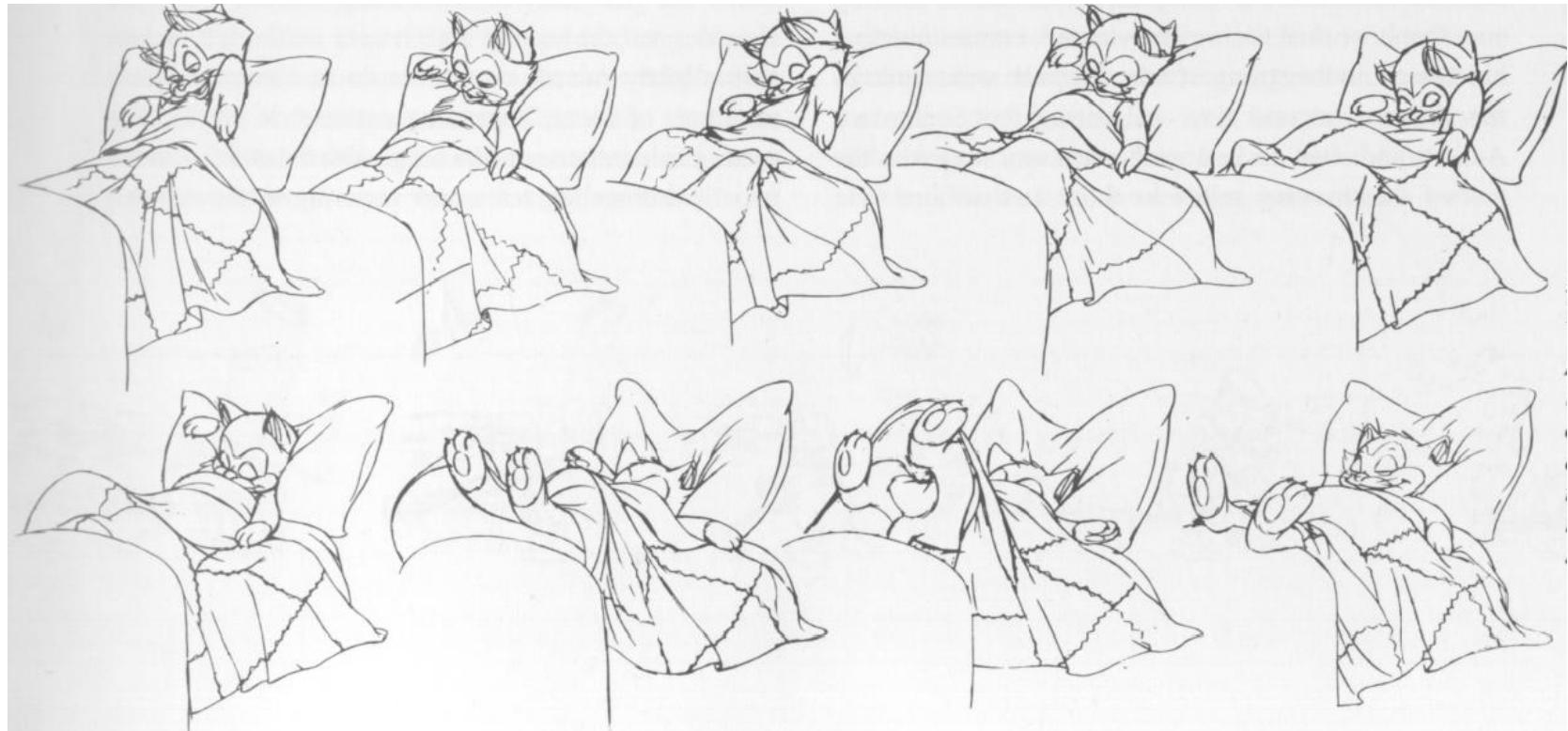


- Exaggerate to make the action more believable.
- Realism and believability are difficult to achieve.
- Convey emotions.

Cartoon Animation, Preston Blair, Walter Foster, 1984

Principles of Animation

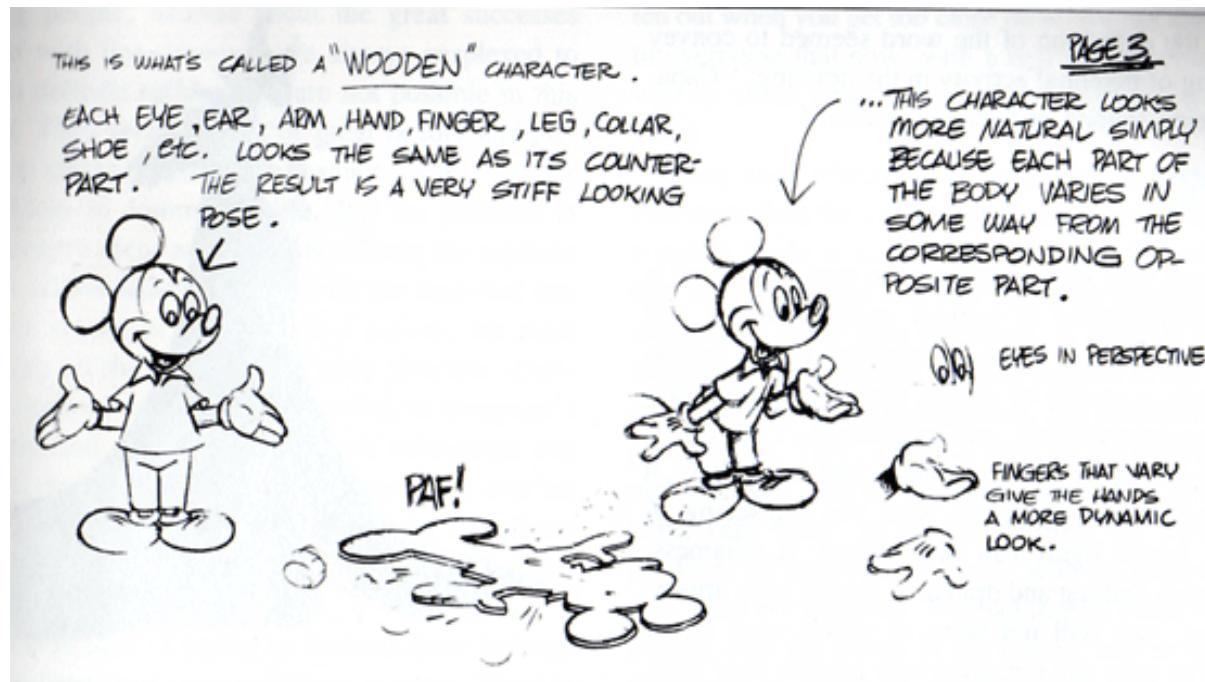
- Secondary Action
 - Action aside from that of the primary character.
 - Must not distract the audience.



"Illusion Of Life" by Frank Thomas & Ollie Johnston, Hyperion Press, (ISBN 0-7868-6070-7), 1981.

Principles of Animation

- Solid Drawing and Appeal
- Characters are solid – have weight in the real world.
- Appeal is what makes people want to look at a character.



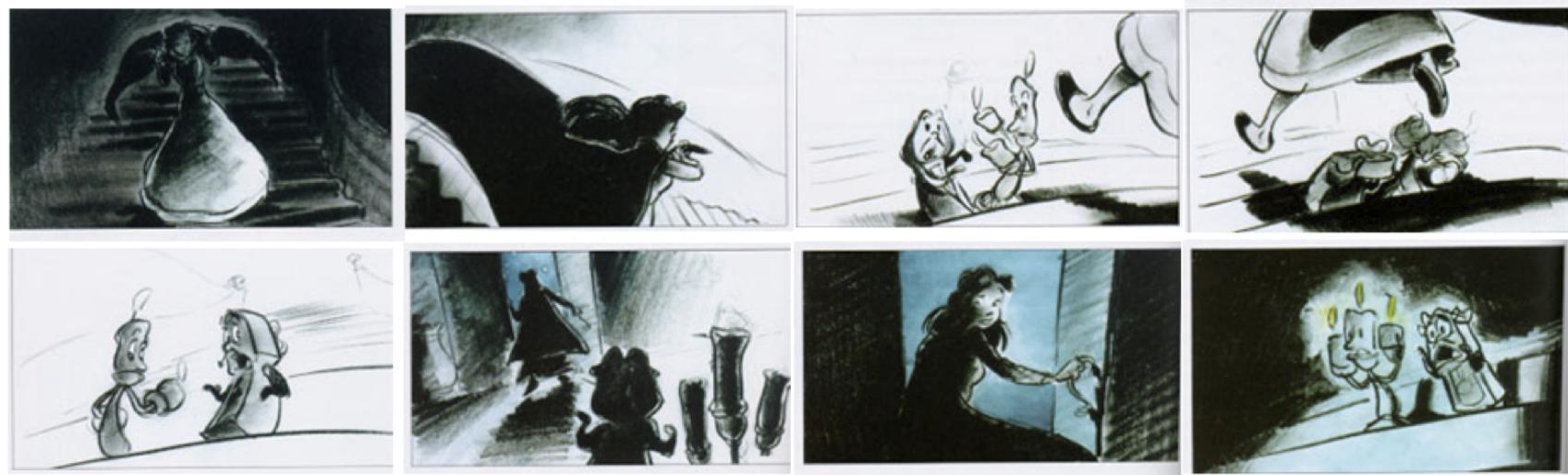
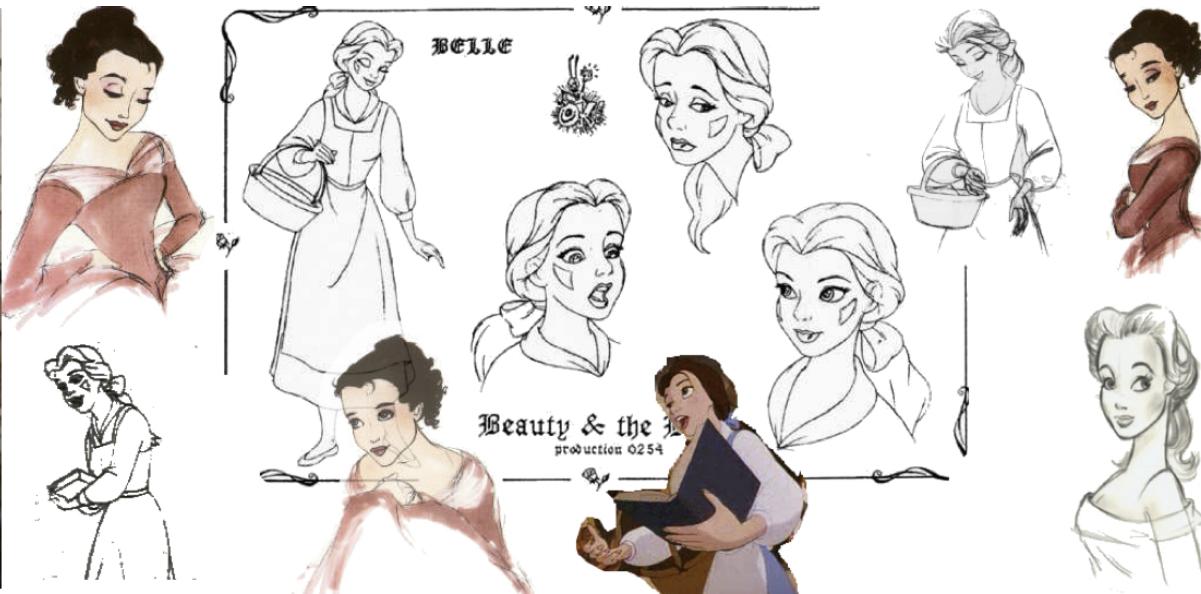
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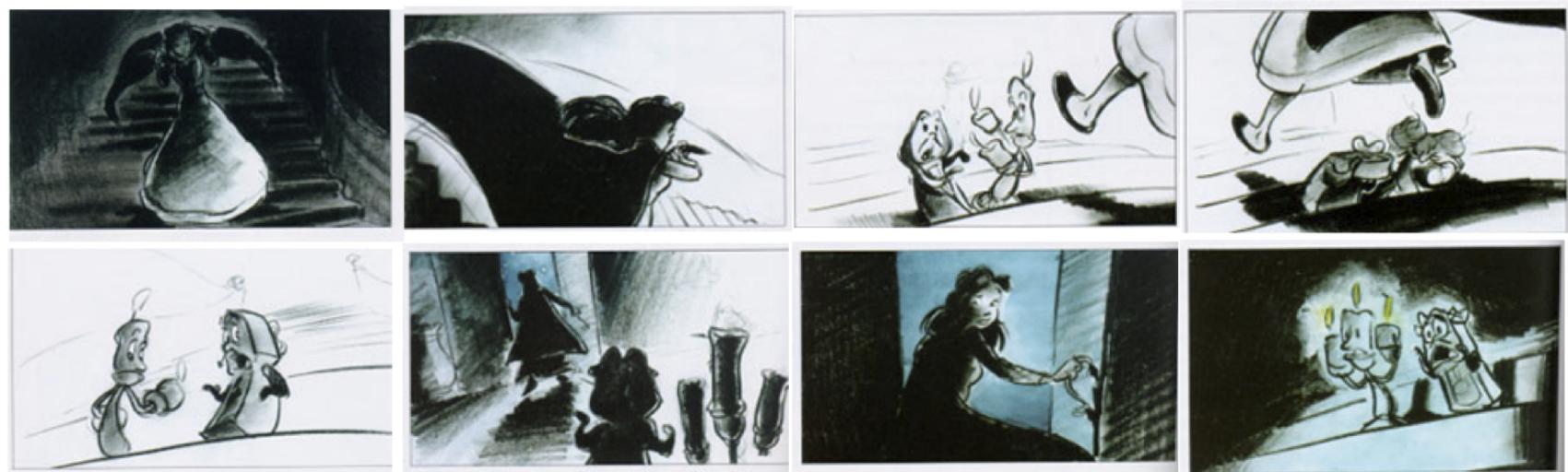
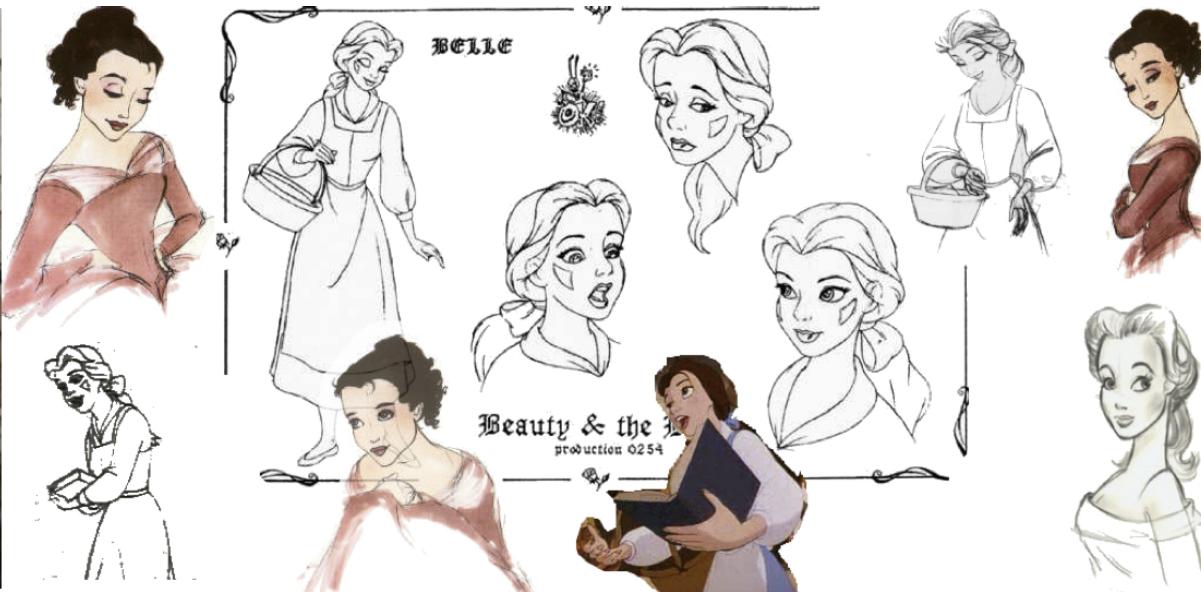


How does all this lead to animation?

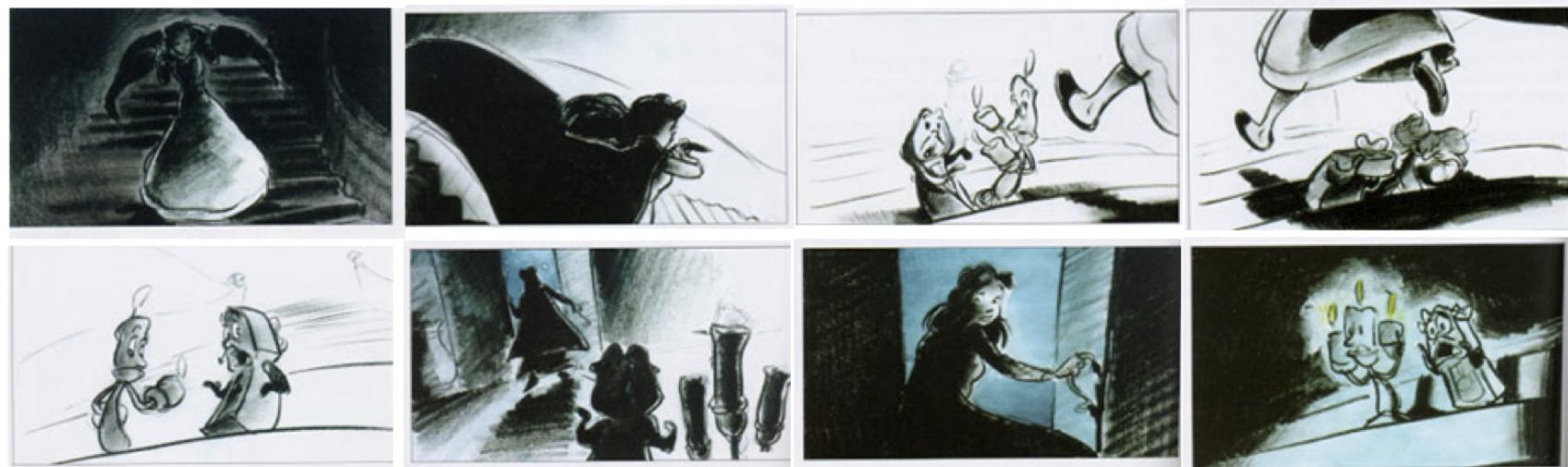
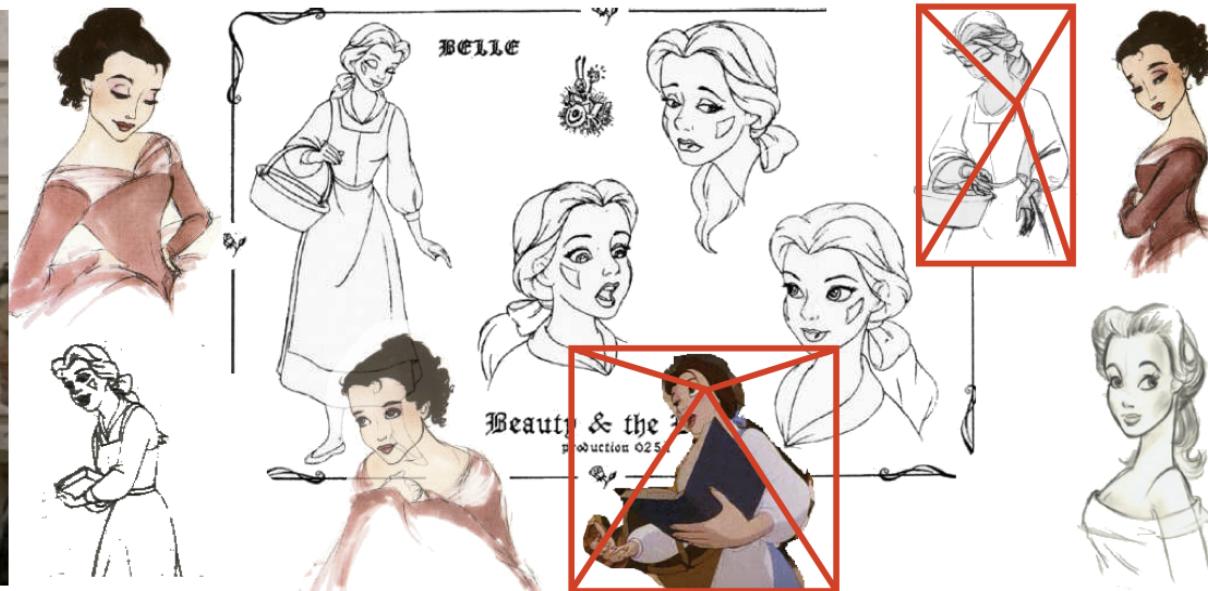
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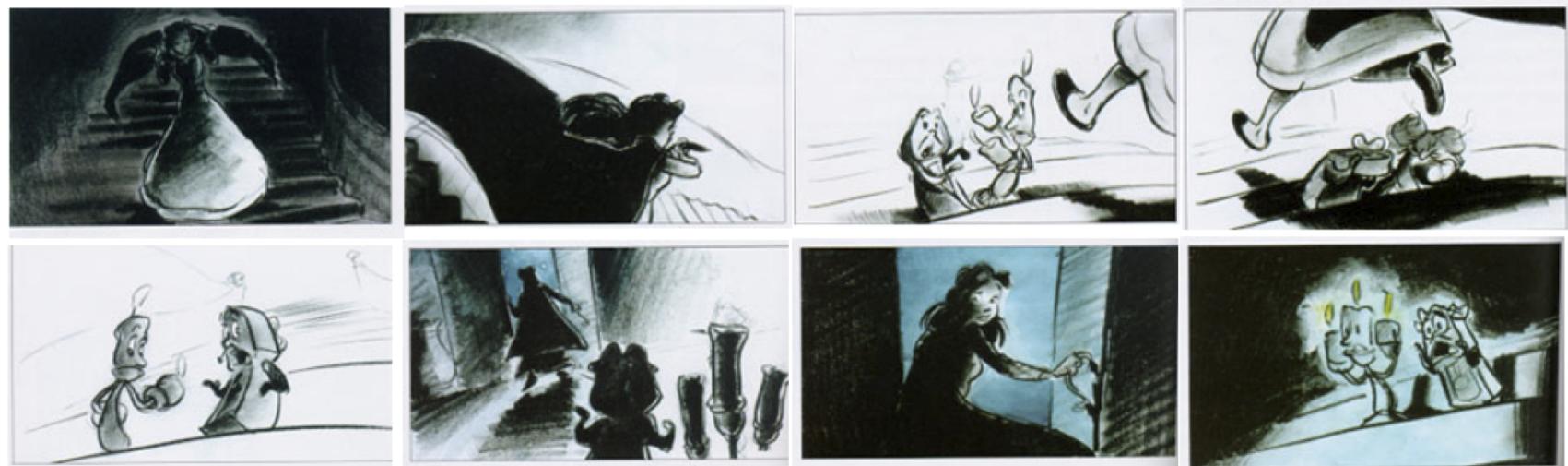
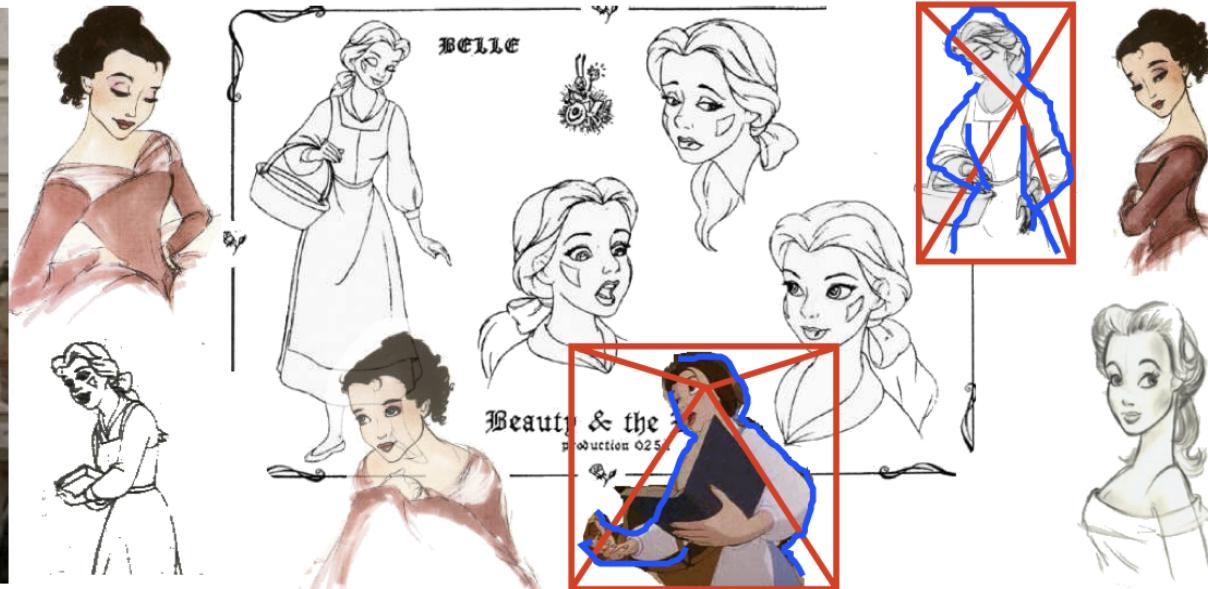
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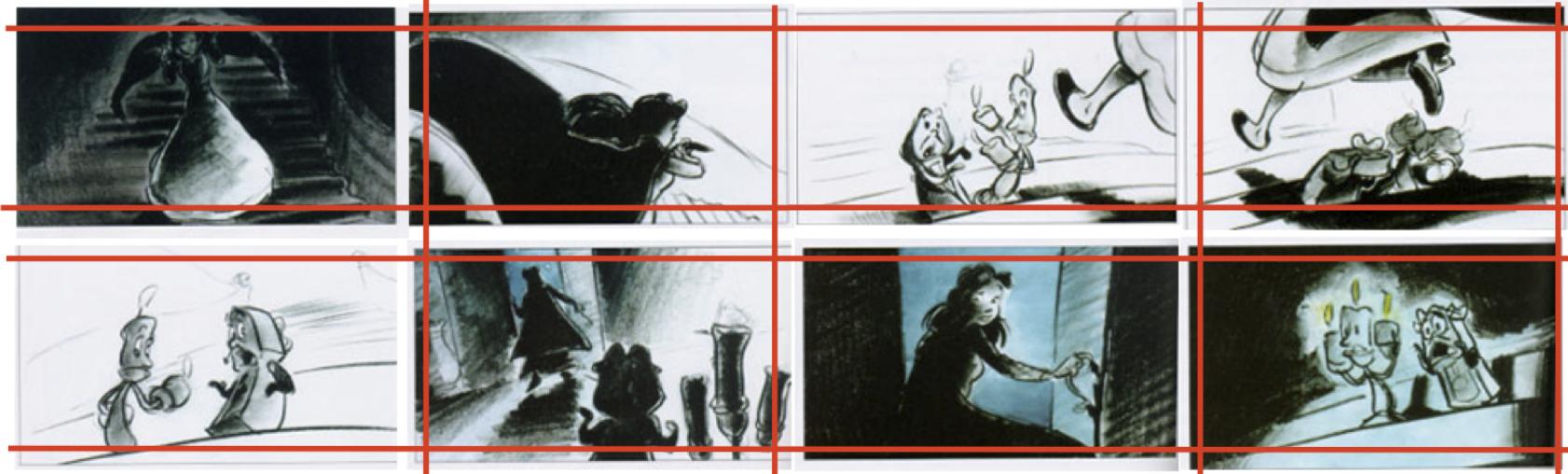
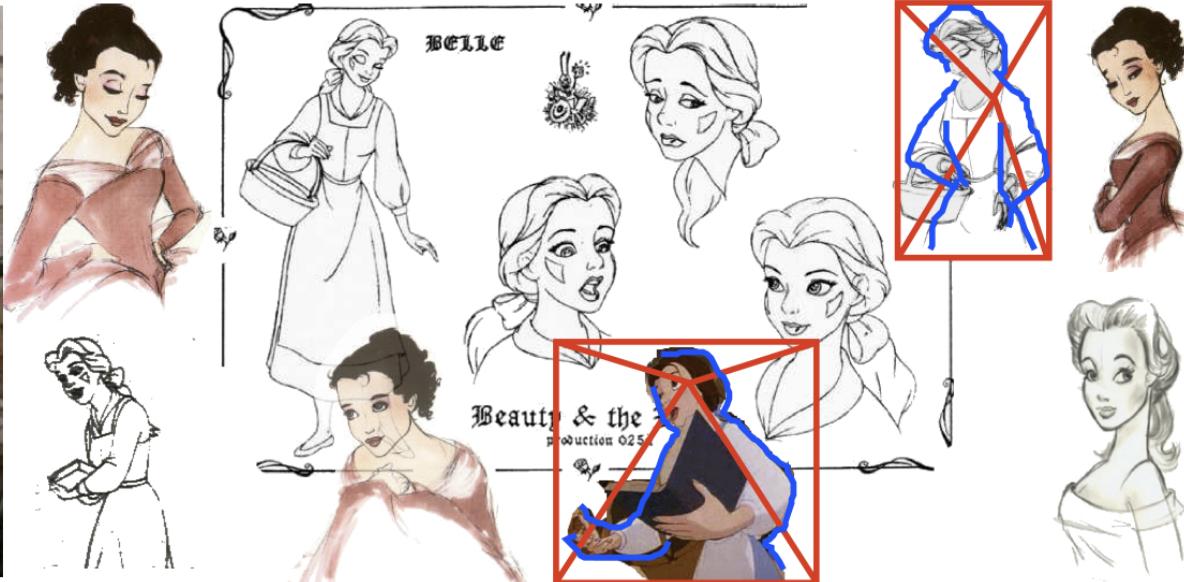
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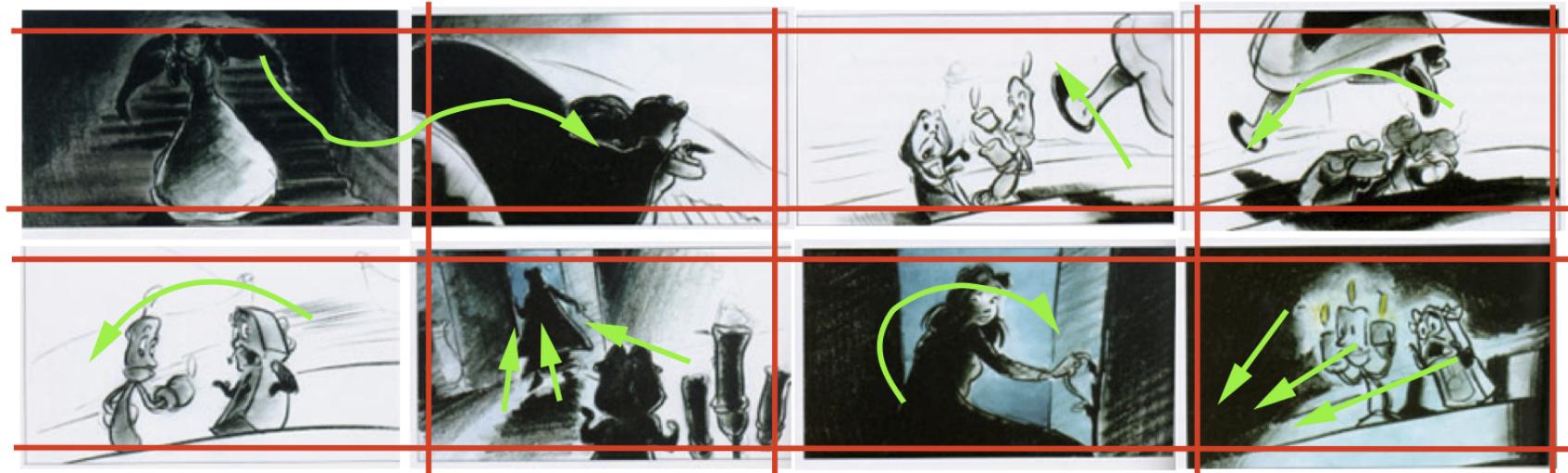
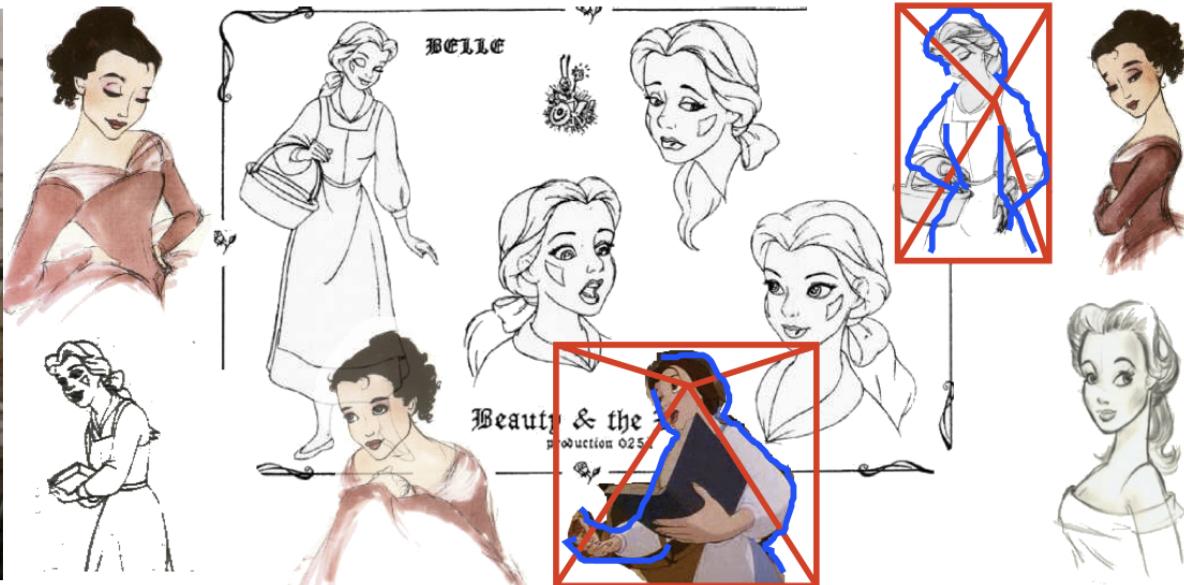
Principles of Animation



Character animation



Principles of Animation





How about 3D Characters?

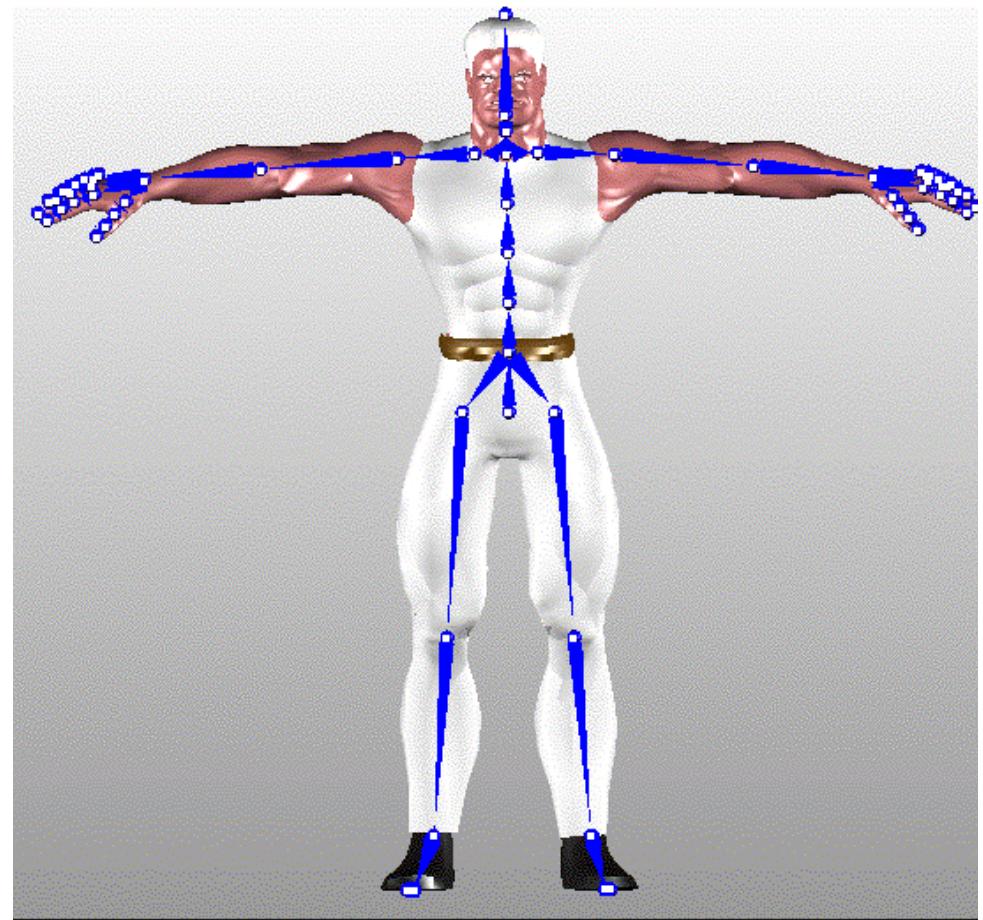


The same principles apply.



Character Animation

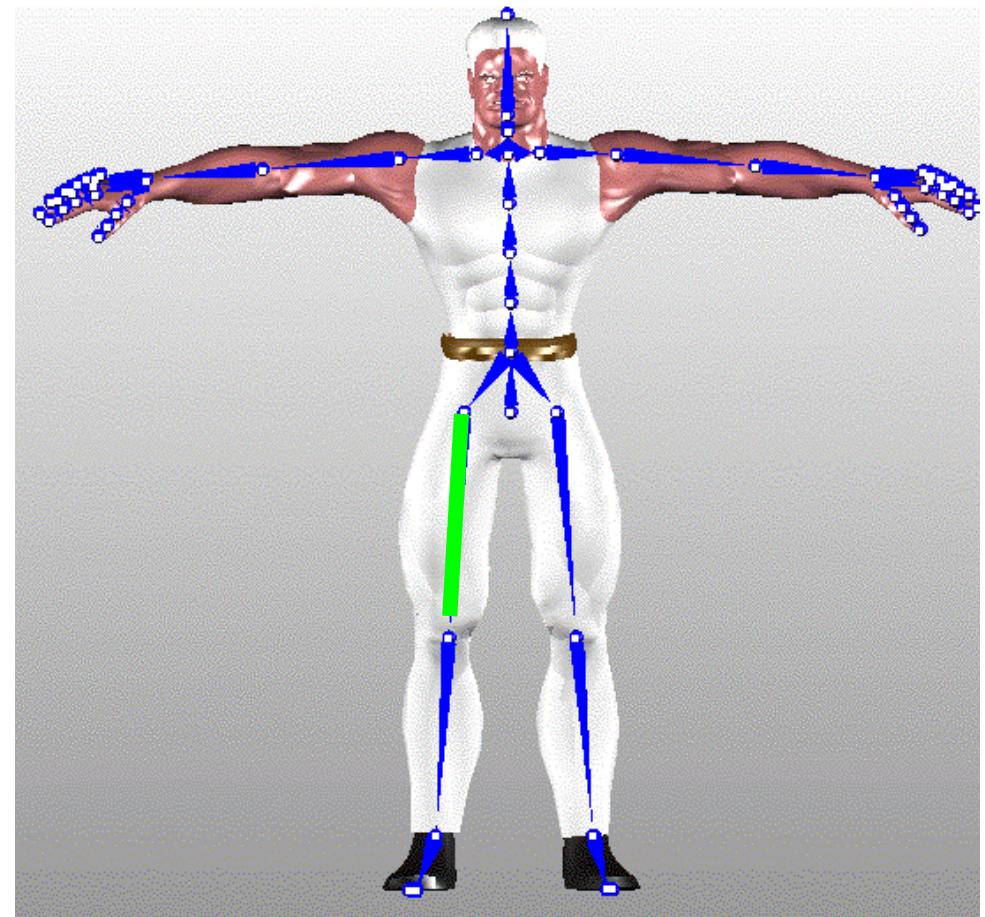
- A character in 3D is just like us.



<http://www.okino.com/conv/skinning.htm>

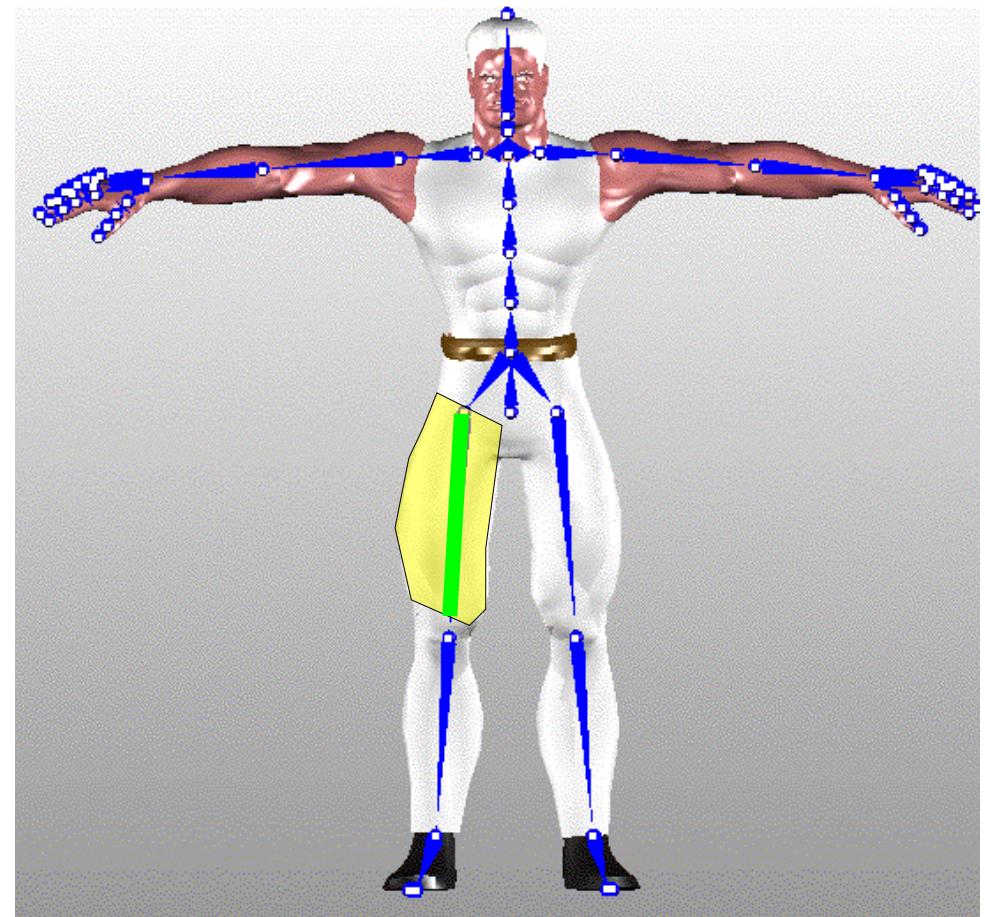
Character Animation

- A character in 3D is just like us.
- Inside they have a skeleton made up of rigid bones.



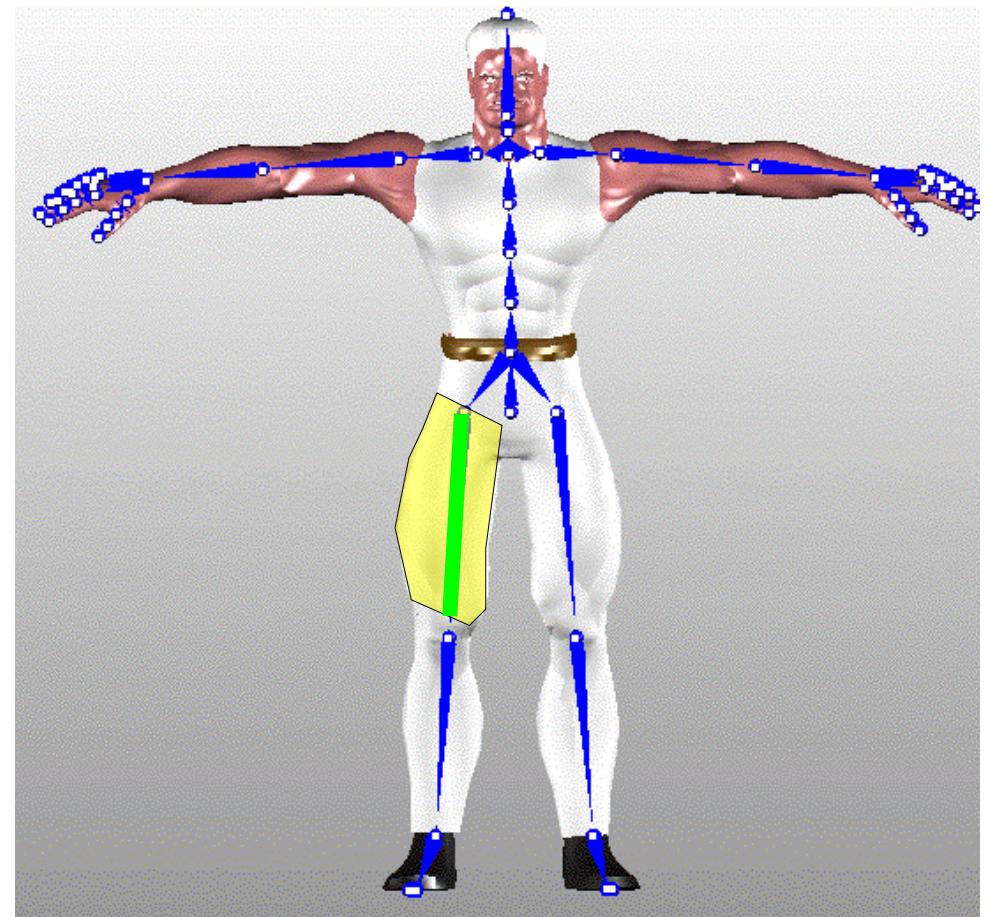
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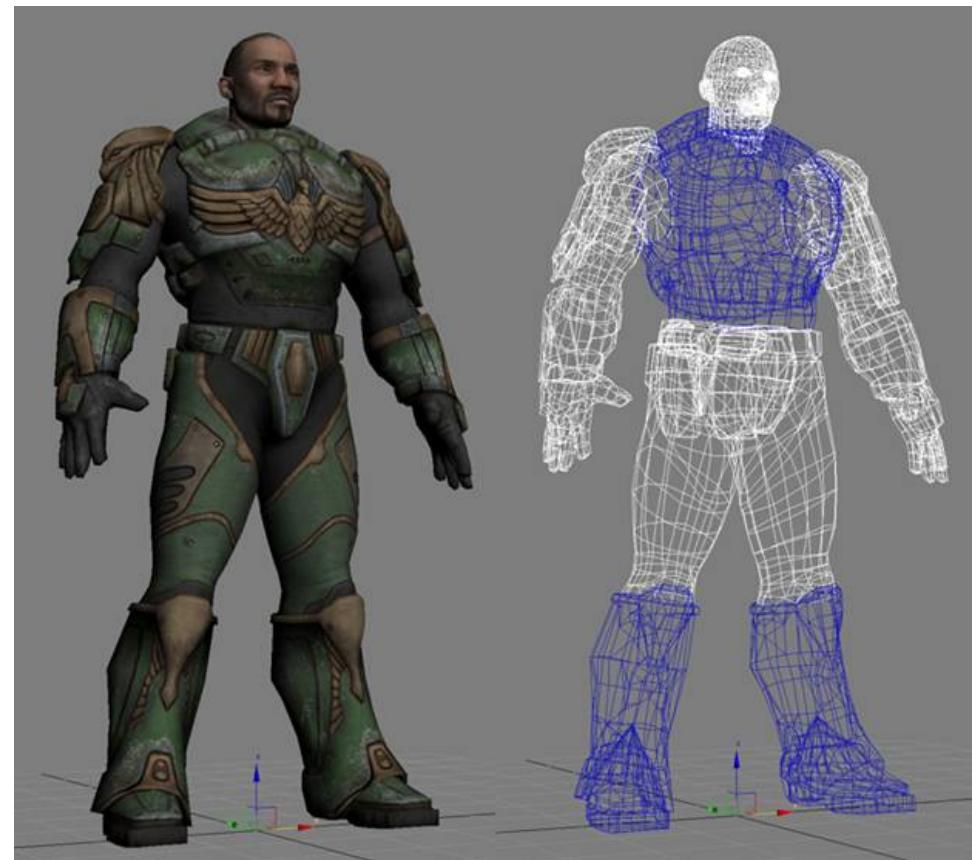
Character Animation

- A character in 3D is just like us
- Inside they have a skeleton made up of rigid bones.
- Outside is a skin mesh.



Character Animation

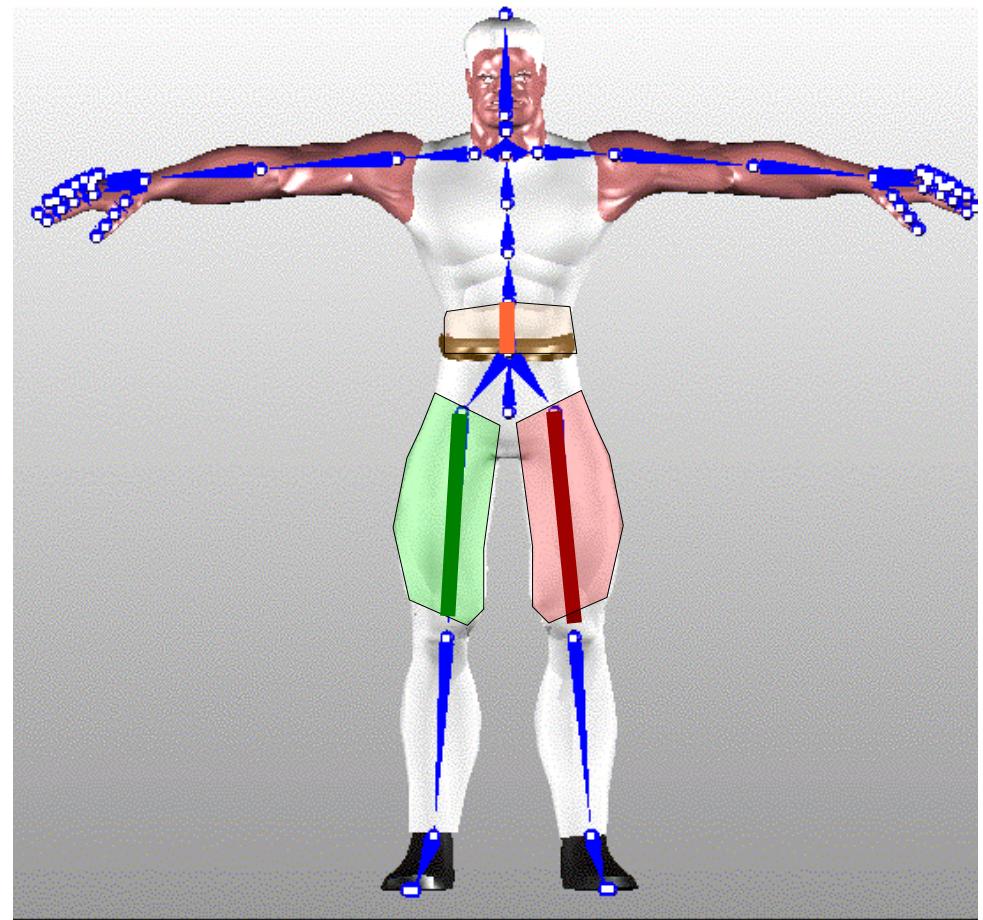
- A character in 3D is just like us
- Inside they have a skeleton made up of rigid bones.
- Outside is a skin mesh.
- The skin mesh can be very detailed – has additional elements to capture look of the character.



<http://udn.epicgames.com/Three/UT3CustomCharacters.html>

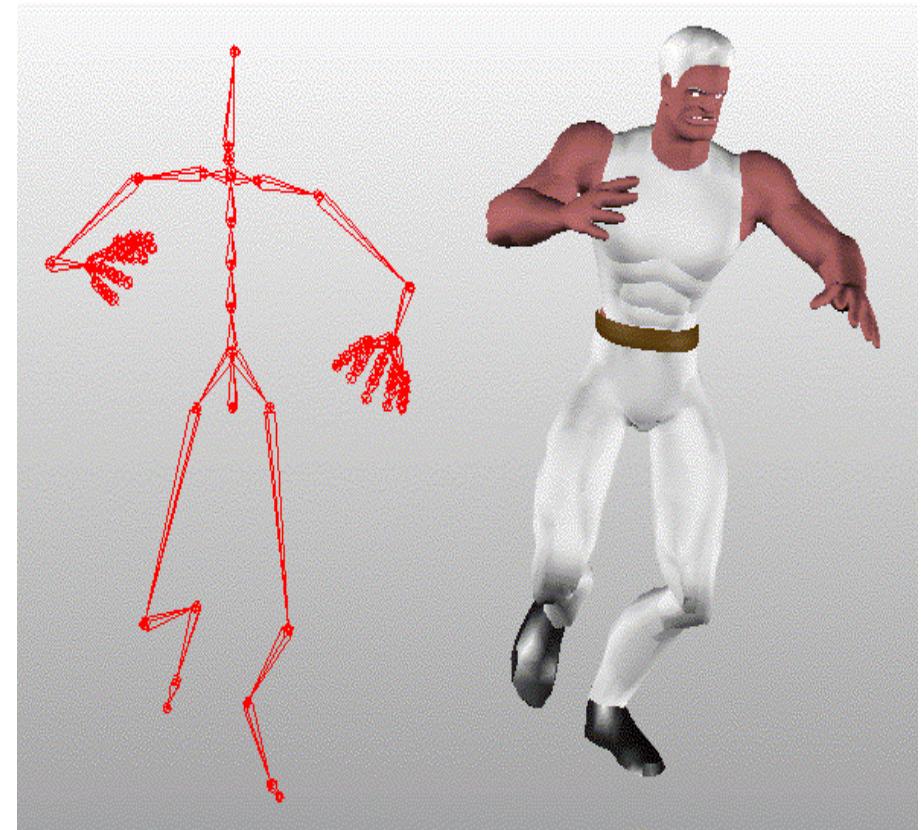
Character Animation

- A character in 3D is just like us
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- Outside is a skin mesh.
- Parts of the skin are associated to the bones.



Character Animation

- A character in 3D is just like us
- Inside they have a skeleton made up of rigid bones.
- Outside is a skin mesh.
- Parts of the skin are associated to the bones.
- We move the bones to move the skin.



<http://www.okino.com/conv/skinning.htm>

Character Animation

- But how do we move the bones?
 - Manually
 - Mimic a performer

