

Visualization, 3D Modeling and Animation

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Ultimate Goal of 3D Modeling:

(for virtual simulation)

To represent a real-world object in digital space.

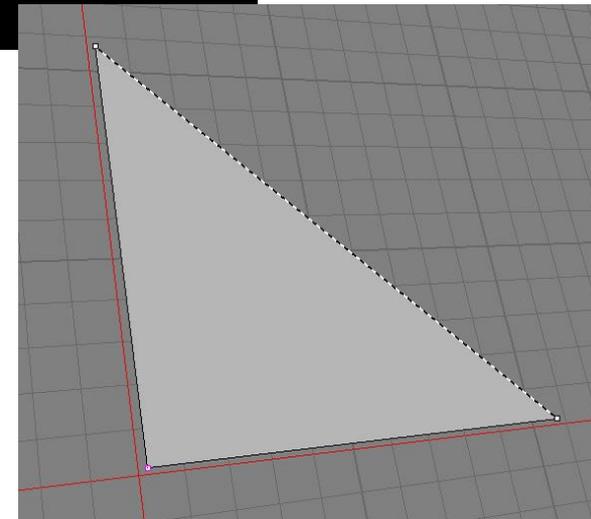
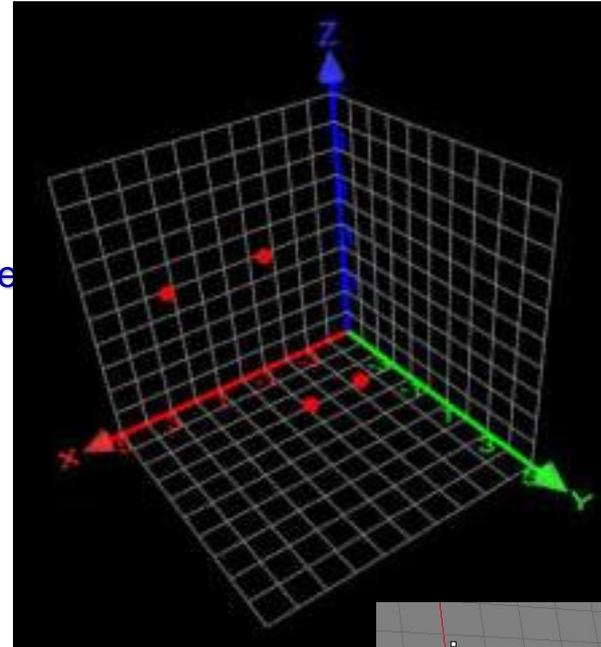
This presentation will cover:

- 3D Fundamentals
- Modeling
- Texturing
- Unwrapping
- Rigging



Visualizing 3D space

- Establishing the axis
 - Represented as X, Y, and Z.
 - Each axis is perpendicular to the plane created by the other two.
- Units and Grid
 - Usually measured in Meters.
- Plotting points
 - Vertices
- Connecting the dots
 - Vertex points connected by Edges in order to build planar Faces
- Observing the world



A World of Triangles!

Primitive Objects

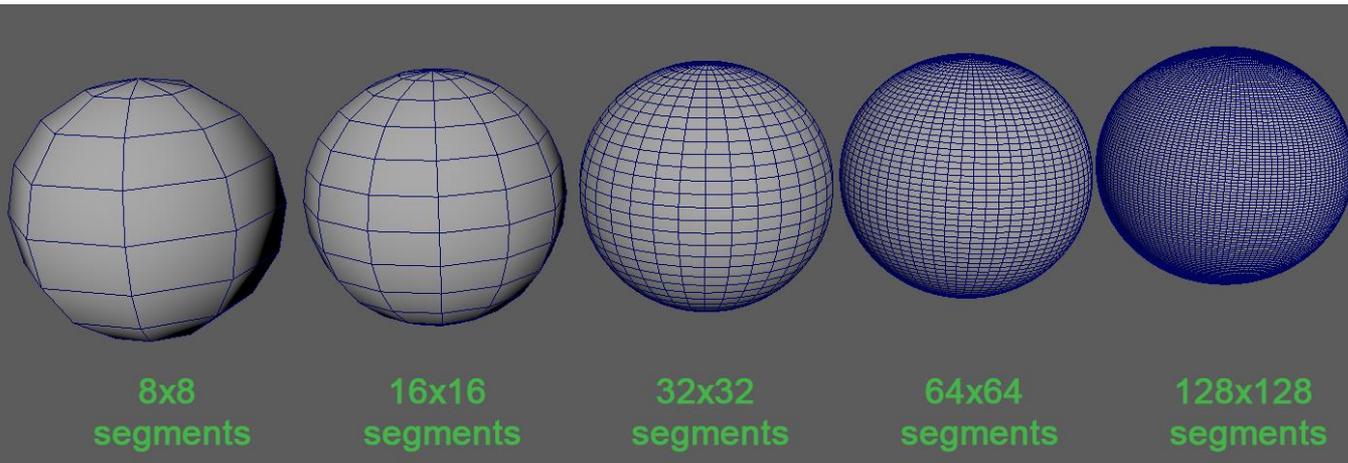
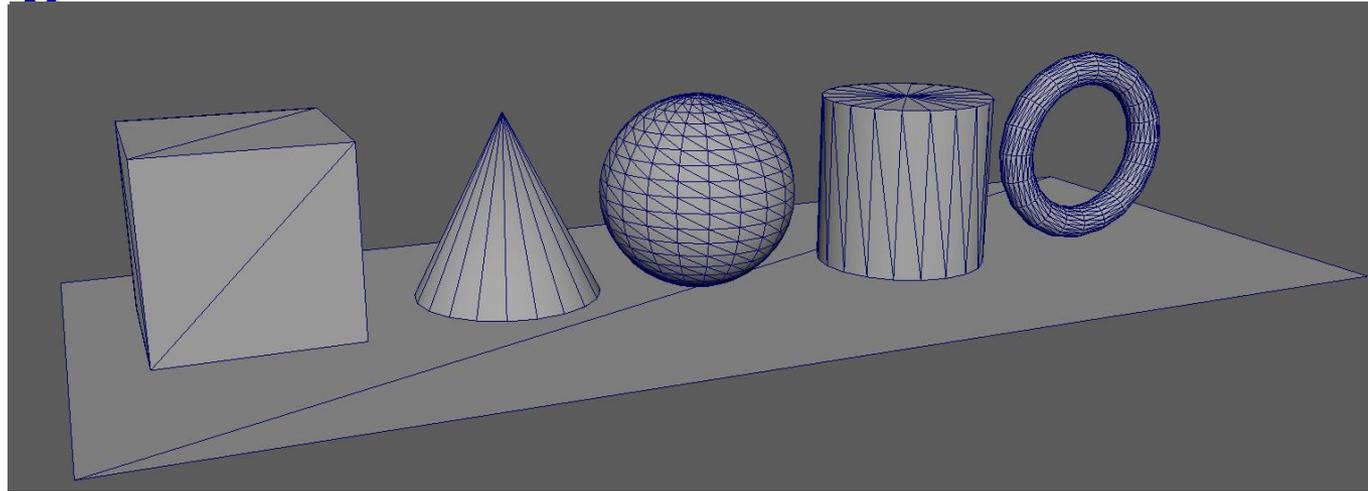
- Cube
- Cone
- Sphere
- Cylinder
- Torus

Number of sides

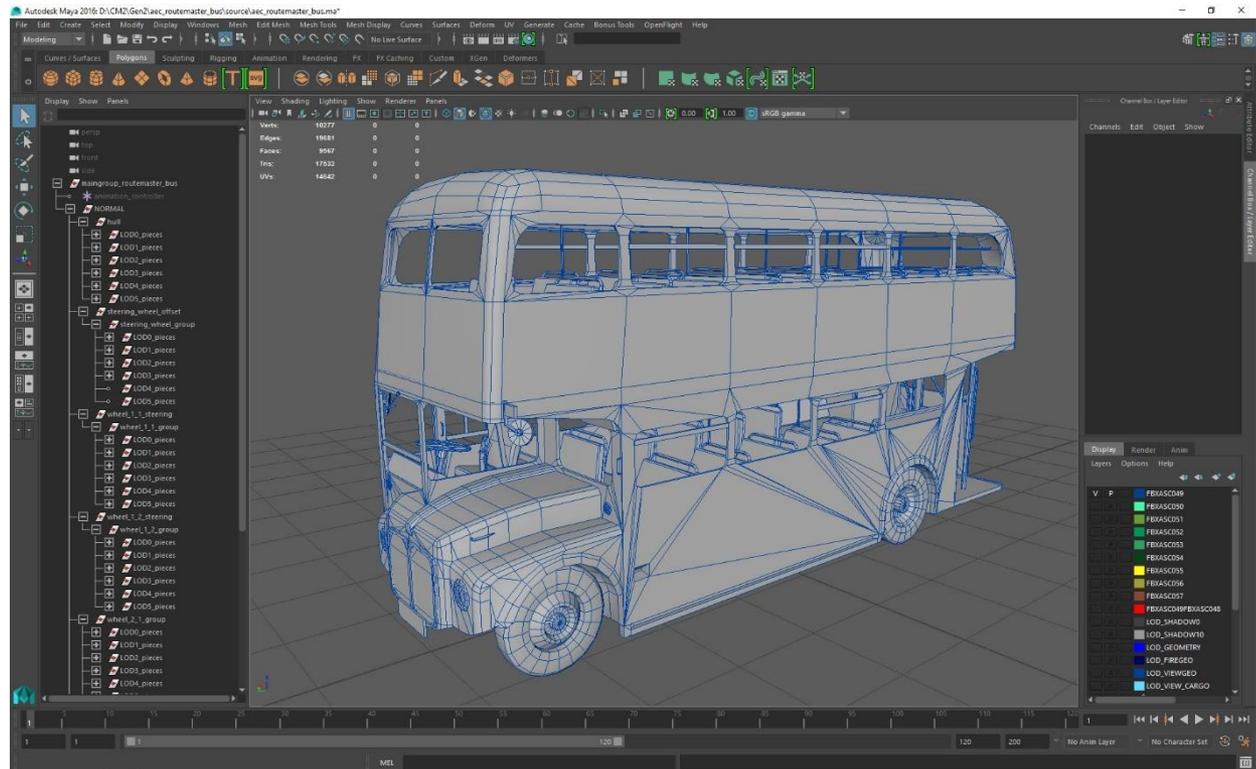
- Triangle
- Quadrilateral
- Polygon (n-gon)

Resolution

- How many polygons do we need?



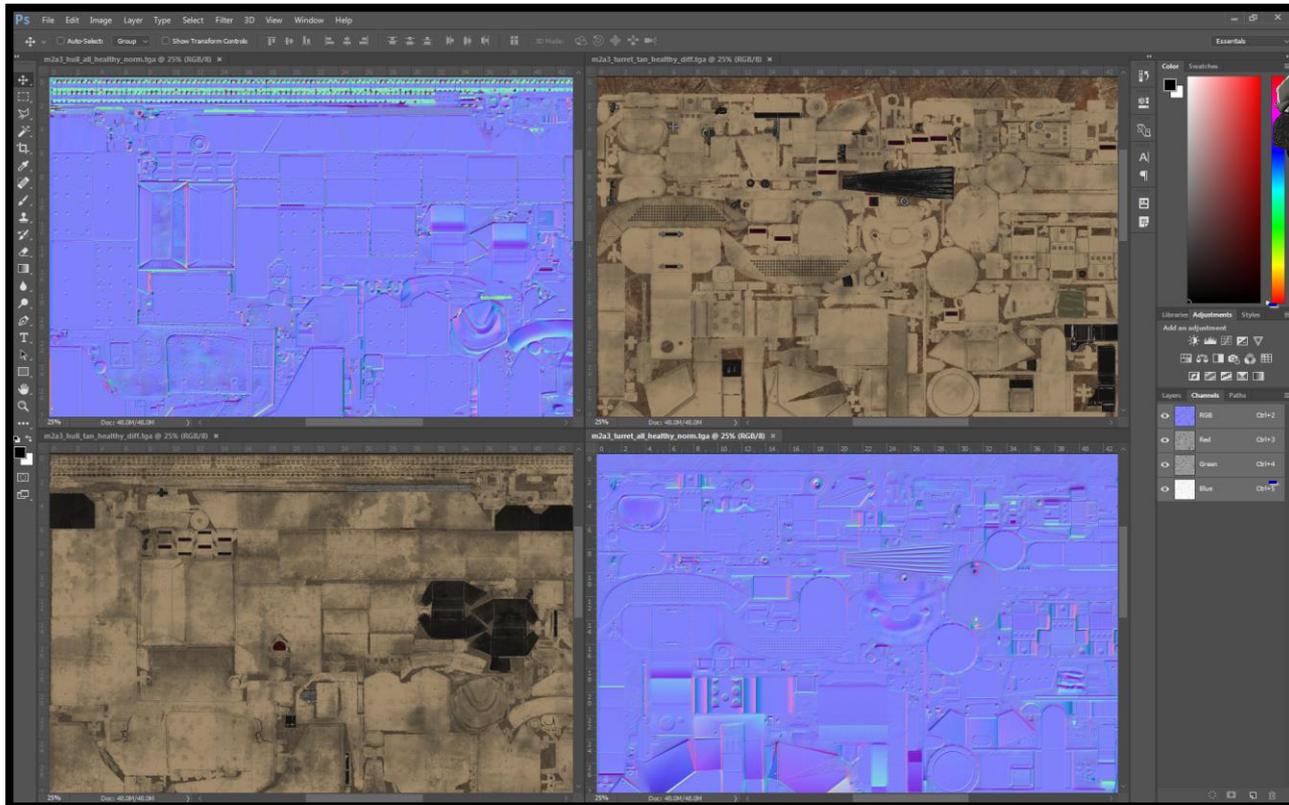
- **3D Modeling** is the process of developing a mathematical representation of any surface of an object (either inanimate or living) in three dimensions via specialized software. (Wikipedia)
- **Software Available**
 - Autodesk 3ds Max, Autodesk Maya, SketchUp, Modo, AutoCAD and many more.
- Once you have chosen a tool, you'll want to start blocking out the shape of the model.
- Start with big shapes and then continue to refine the details until you reach your target budget.
- Before you begin modeling anything – collect and sort your source imagery!



Painting a texture

The goal of texturing is to add material definition and color to make a model look realistic.

- Adding highlights and shadows can help give the impression of depth. Adding dirt and scratch effects can make a model feel grounded in a scene.
- There are several texturing tools out there, but in most cases the industry standard is Adobe Photoshop.

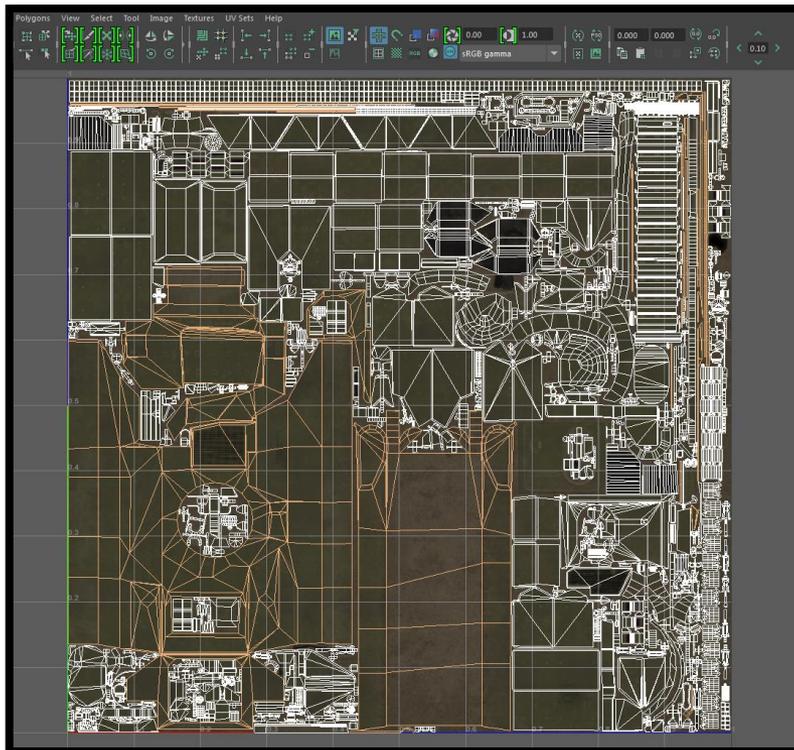
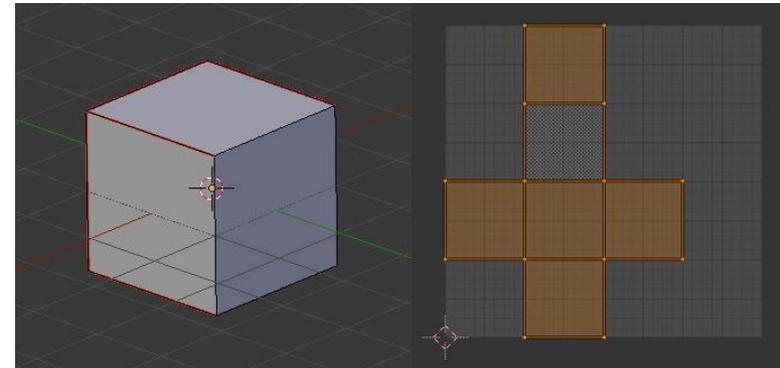


Modern gaming engines are now using a method called “Physically Based Rendering (PBR)” to more accurately depict how light interacts with a material surface.

This approach uses the shape and shading of the model geometry to help drive the appearance of the texture. Procedurally generating textures can save time and help to standardize the look across multiple models when set up properly.

Neat. But how do you get a texture onto a model?

- Through a process called UV mapping.
 - This entails taking each Three-Dimensional object, and then slicing it open along its edges, in order to unfold it into a Two-Dimensional surface.
 - It gets a *tiny* bit more tricky on our tank example. Sometimes a complex model will need to be separated into multiple maps.



- Another way to think of it is to imagine gift wrapping an oddly shaped present.

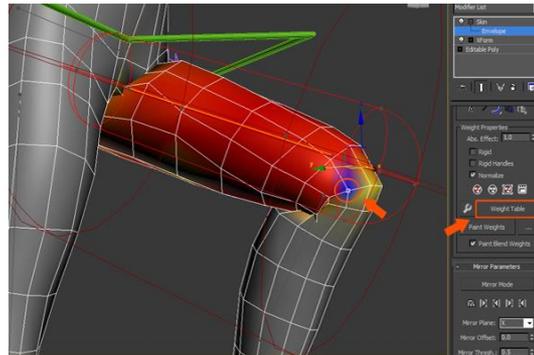


- Now how do you do this efficiently without wasting paper? **8**

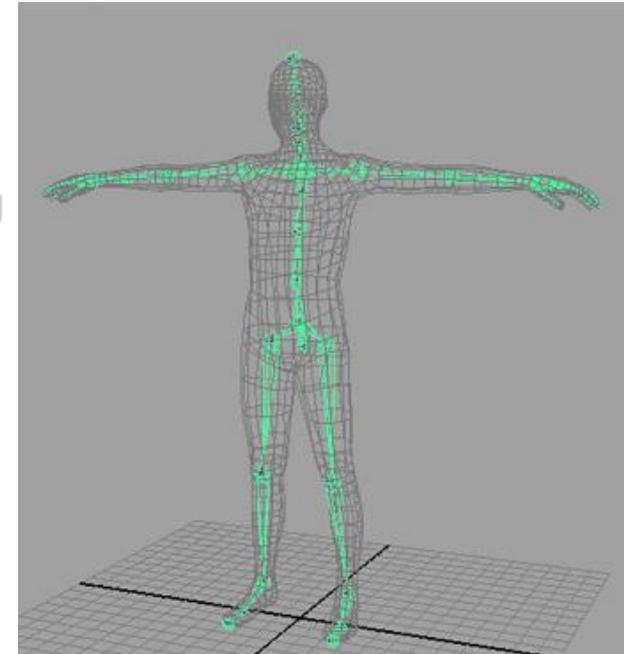
Rigging

- Before a 3D model can be animated, the stationary geometry must first be bound onto a logical control structure.
- This is called a skeleton (or rig) and bones are parented to one another in order to form a logical chain.
 - In this rig, bending the leg will also move the corresponding foot.
- Bending more complex joints can lead to issues where the geometry can stretch and fold unrealistically. To fix this vertex points on the model can be “weighted” to move along with multiple bones, to varying levels.

- A vehicle with articulating parts such as a tank turret with an elevating cannon can be assembled into a similar hierarchy.



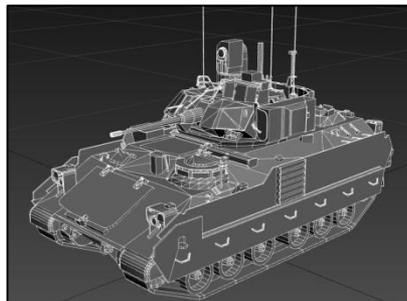
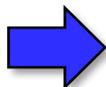
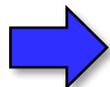
- Making a good rig is a more of an engineering task than an artistic one, but it is a vital step in finalizing a useful 3D asset.
 - Especially if the model is intended for use in a real-time game engine, a rendered image, or animated video sequence.



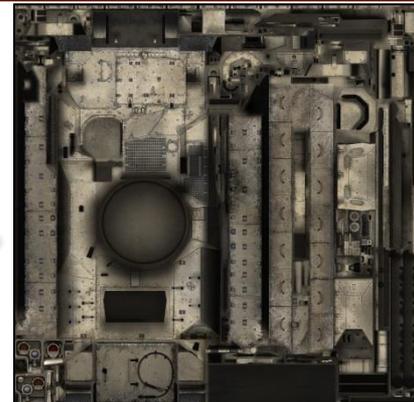
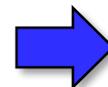
The AEgis Modeling Process



Receive Model Request
& Gather Source



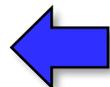
Build Model Geometry



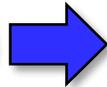
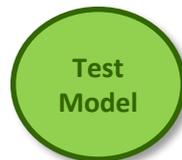
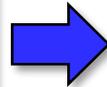
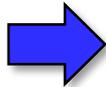
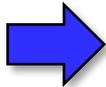
Create Texture Maps



Build Geometry Levels of Detail (LOD)



Build Damage State(s)



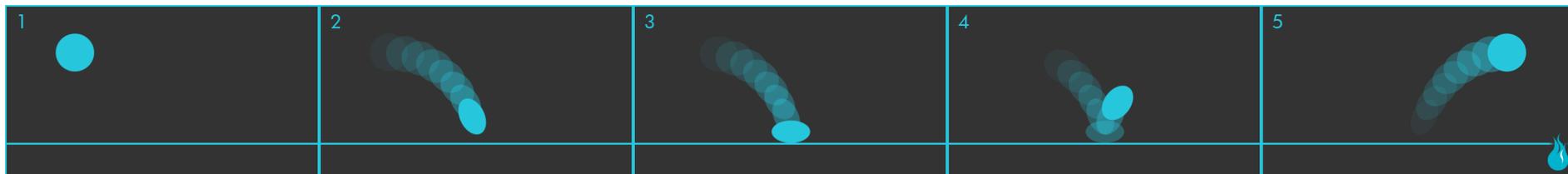
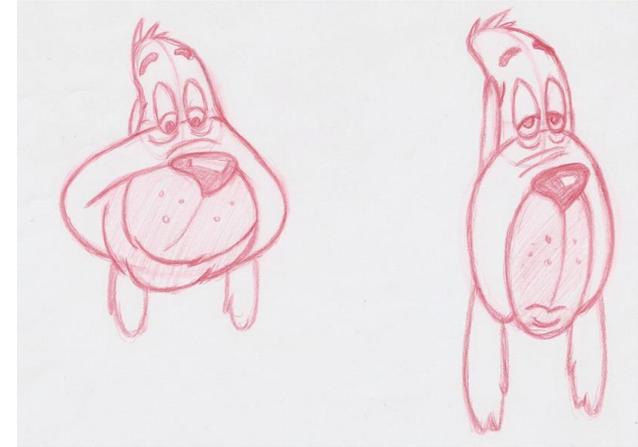


Animation is composed of 12 principles

- Squash and Stretch
- Anticipation
- Staging
- Straight ahead and Pose to Pose Animation
- Follow Through and Overlapping Action
- Slow-out and Slow-in
- Arcs
- Secondary Action
- Timing
- Exaggeration
- Solid Drawing
- Appeal

Squash and Stretch

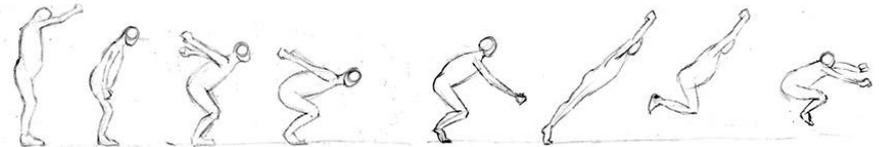
- This action gives the illusion of weight and volume to a character as it moves.
- Squash and stretch is useful in animating dialogue and doing facial expressions.
- How extreme the use of squash and stretch is, depends on what is required in animating the scene.
- This is the most important element.



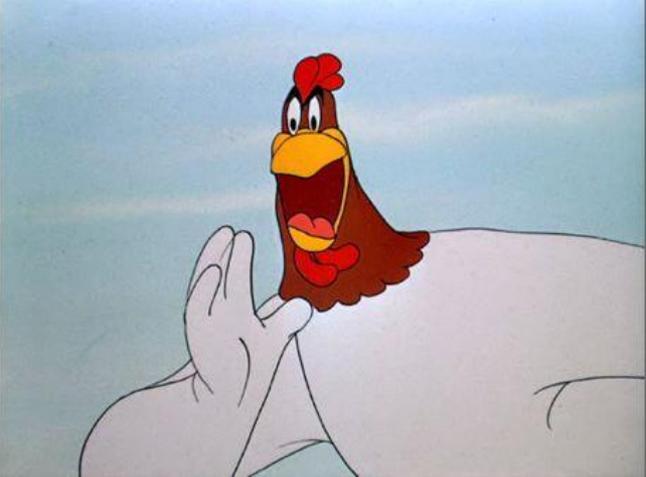
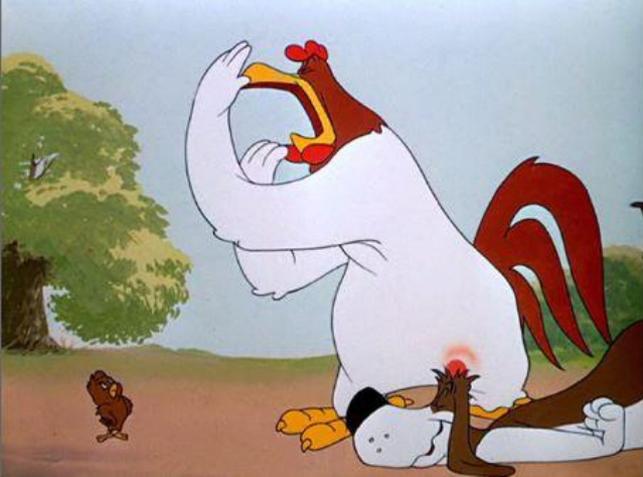
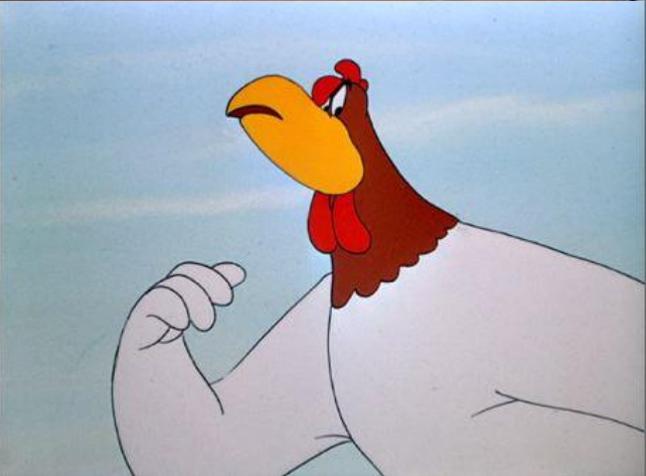
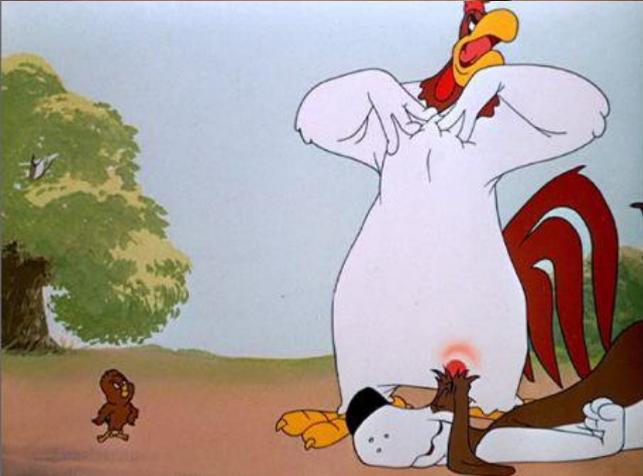
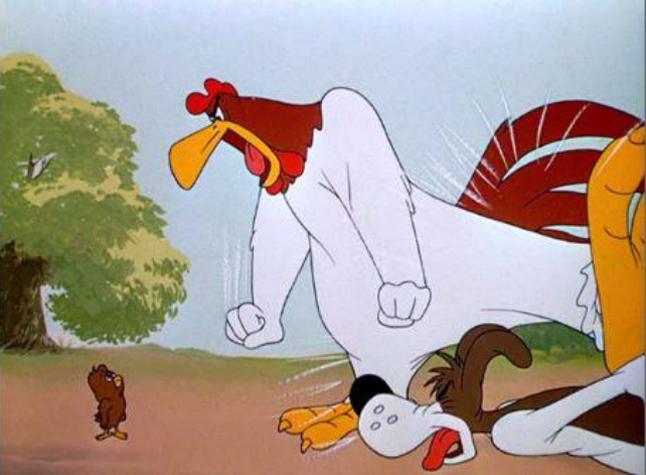
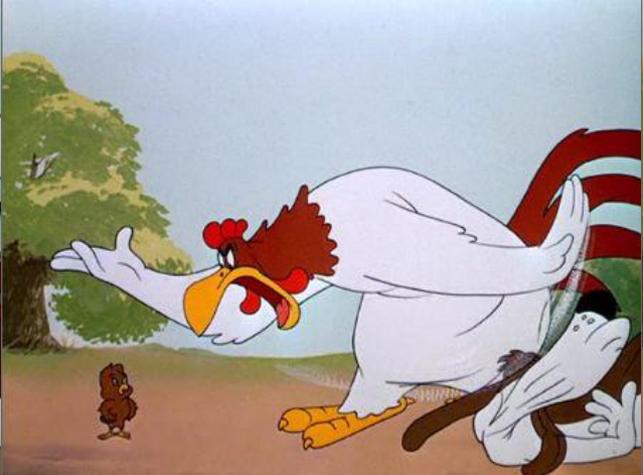
- This movement prepares the audience for a major action the character is about to perform, such as, starting to run, jump or change expression.
- A dancer does not just leap off the floor. A backwards motion occurs before the forward action is executed. The backward motion is the anticipation.
- Almost all real action has major or minor anticipation such as a pitcher's wind-up or a golfers' back swing.
- Feature animation is often less broad than short animation unless a scene requires it to develop a characters personality.



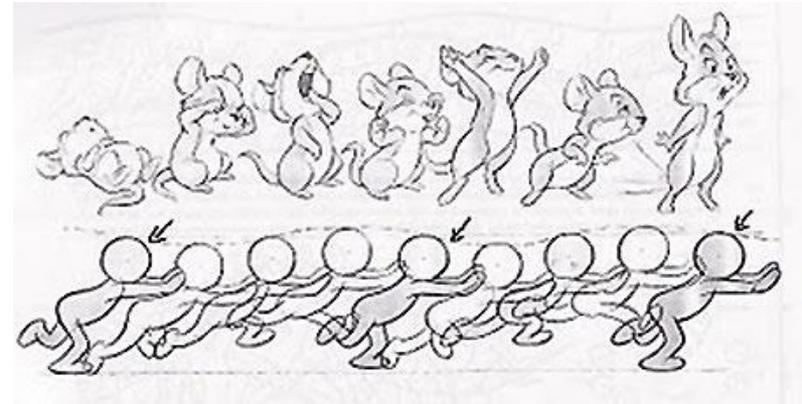
Victoria Breton
ANIM250 02
Standing Long Jump



- **Staging is how you present objects. It provides context for the object and the animation which helps tell your story.**
- **A pose or action should clearly communicate to the audience the attitude, mood, reaction or idea of the character as it relates to the story and continuity of the story line.**
- **The effective use of long, medium, or close up shots, as well as camera angles helps in telling the story.**
- **Staging directs the audience's attention to the story or idea being told. Care must be taken in background design so it isn't obscuring the animation or competing with it due to excess detail behind the animation.**
- **Background and animation should work together as a pictorial unit in a scene.**

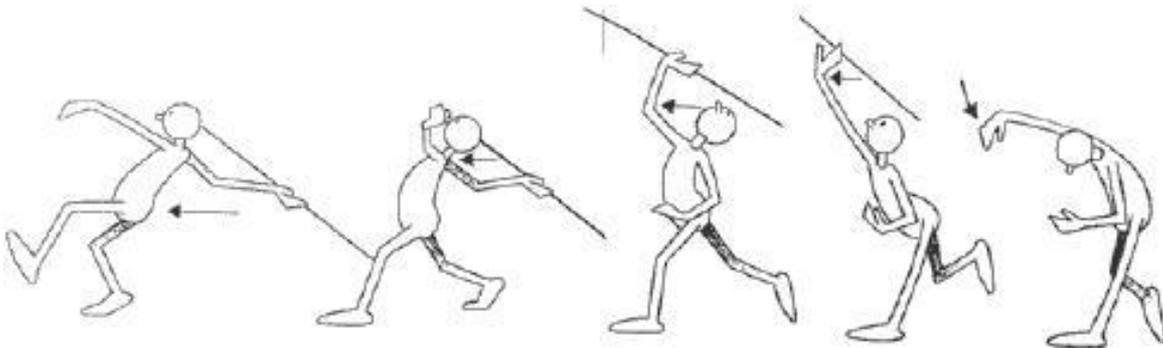
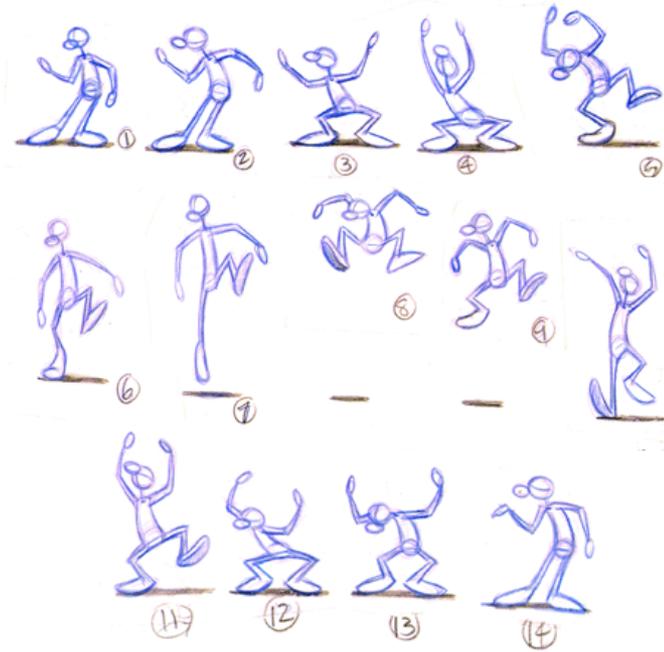


- Straight ahead animation starts at the first drawing and works drawing to drawing to the end of a scene.
- You can lose size, volume, and proportions with this method, but it does have spontaneity and freshness. Fast, wild action scenes are done this way.
- Pose to Pose is more planned out and charted with key drawings done at intervals throughout the scene.
- Size, volumes, and proportions are controlled better this way, as is the action.

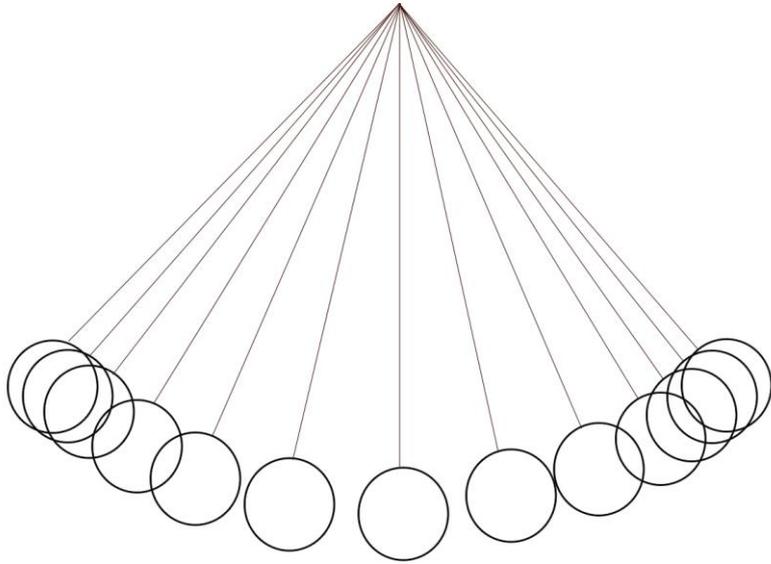


- **Follow through** is when the main body of the character stops and all other parts continue to catch up to the main mass of the character, such as arms, long hair, clothing, coat tails or a dress, floppy ears or a long tail (these follow the path of action). Nothing stops all at once.
- **Overlapping action** is when the character changes direction while his clothes or hair continues forward.
- The character is going in a new direction, to be followed, a number of frames later, by his clothes in the new direction. "DRAG," in animation, for example, would be when Goofy starts to run, but his head, ears, upper body, and clothes do not keep up with his legs.
- Timing becomes critical to the effectiveness of drag and the overlapping action.

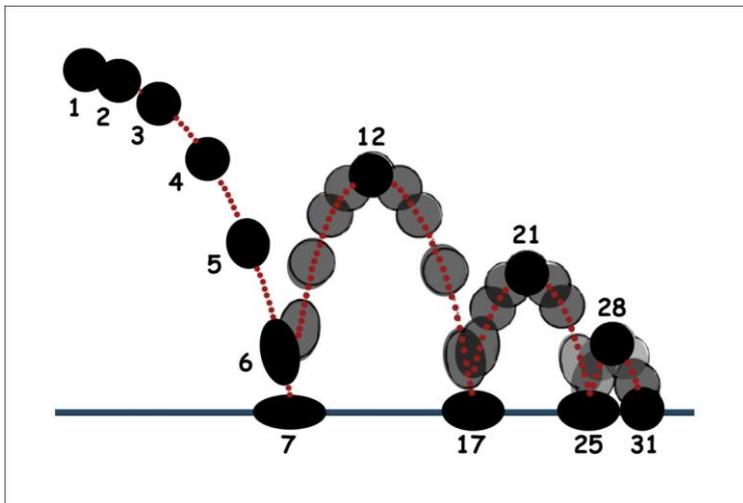
Follow Through and Overlapping Action



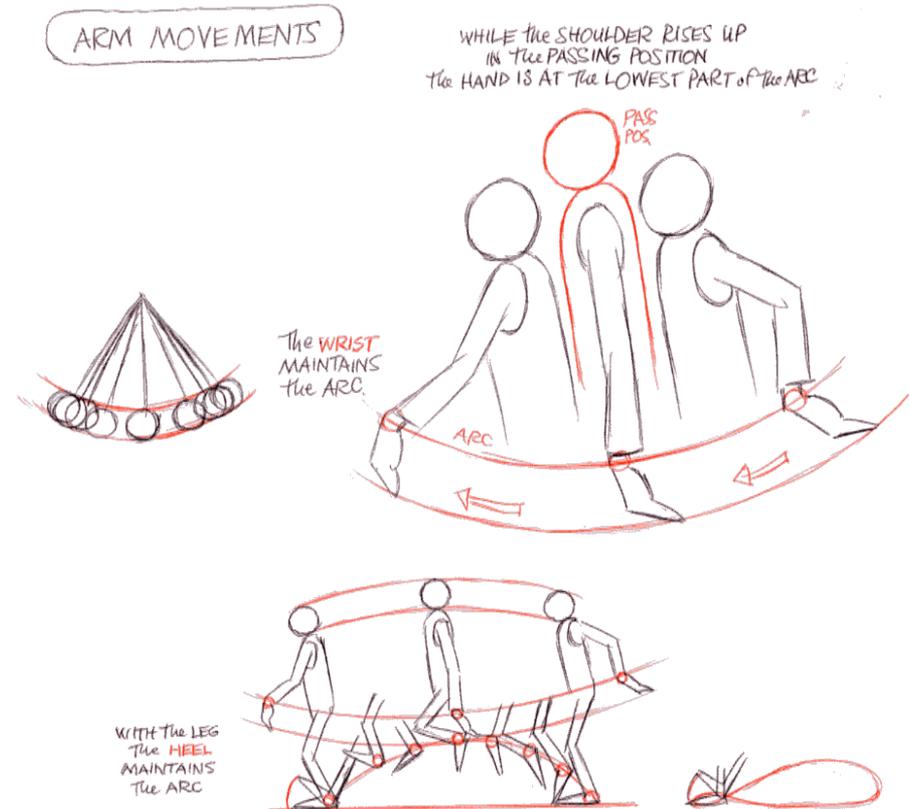
Slow-out and Slow-in



- As action starts, we have more drawings near the starting pose, one or two in the middle, and more drawings near the next pose.
- Fewer drawings make the action faster and more drawings make the action slower.
- Slow-ins and slow-outs soften the action, making it more life-like.
- For a gag action, we may omit some slow-out or slow-ins for shock appeal or the surprise element. This will give more snap to the scene.

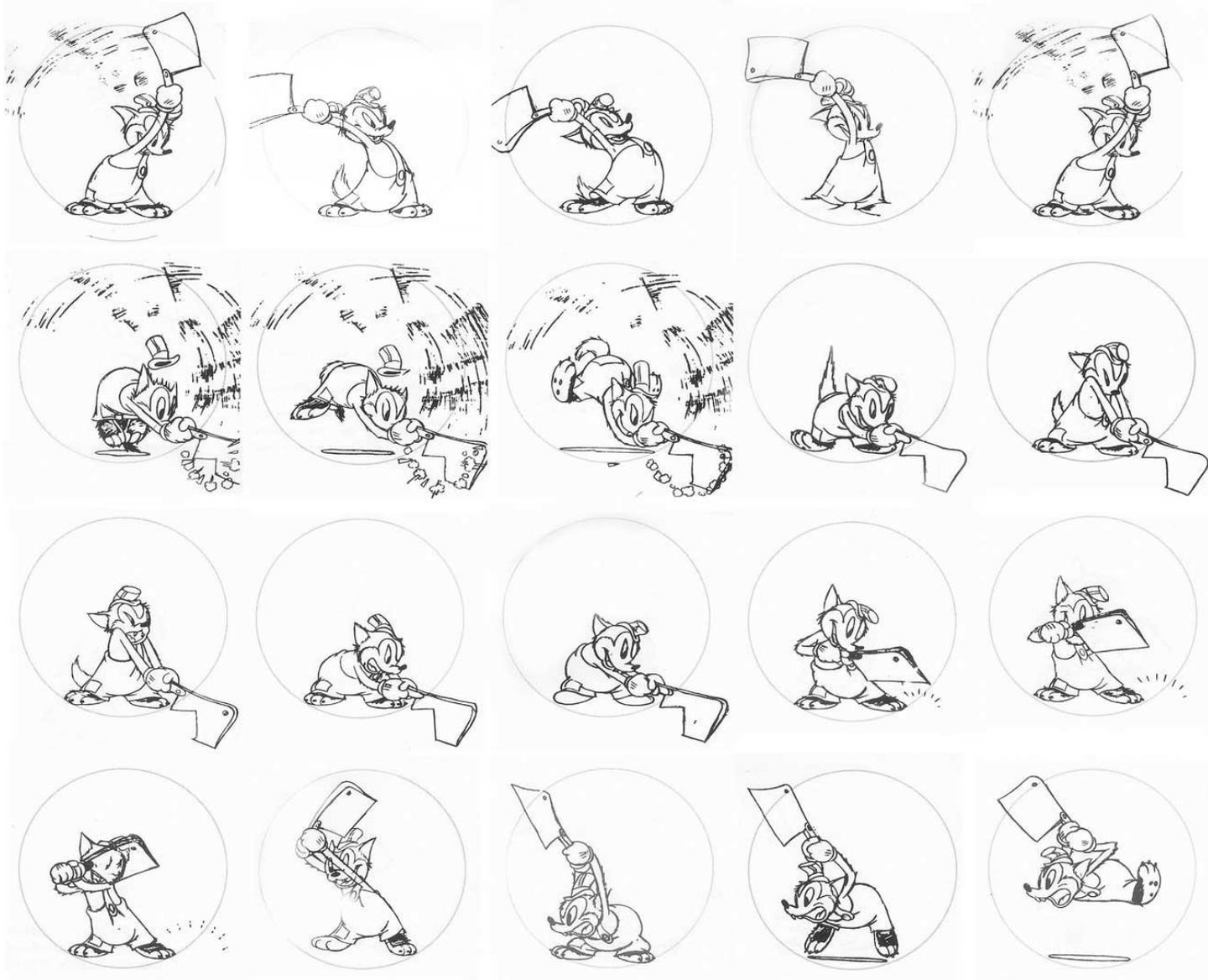


- All actions, with few exceptions (such as the animation of a mechanical device), follow an arc or slightly circular path. This is especially true of the human figure and the action of animals.
- Arcs give animation a more natural action and better flow. Think of natural movements in the terms of a pendulum swinging. All arm movement, head turns and even eye movements are executed on an arcs.



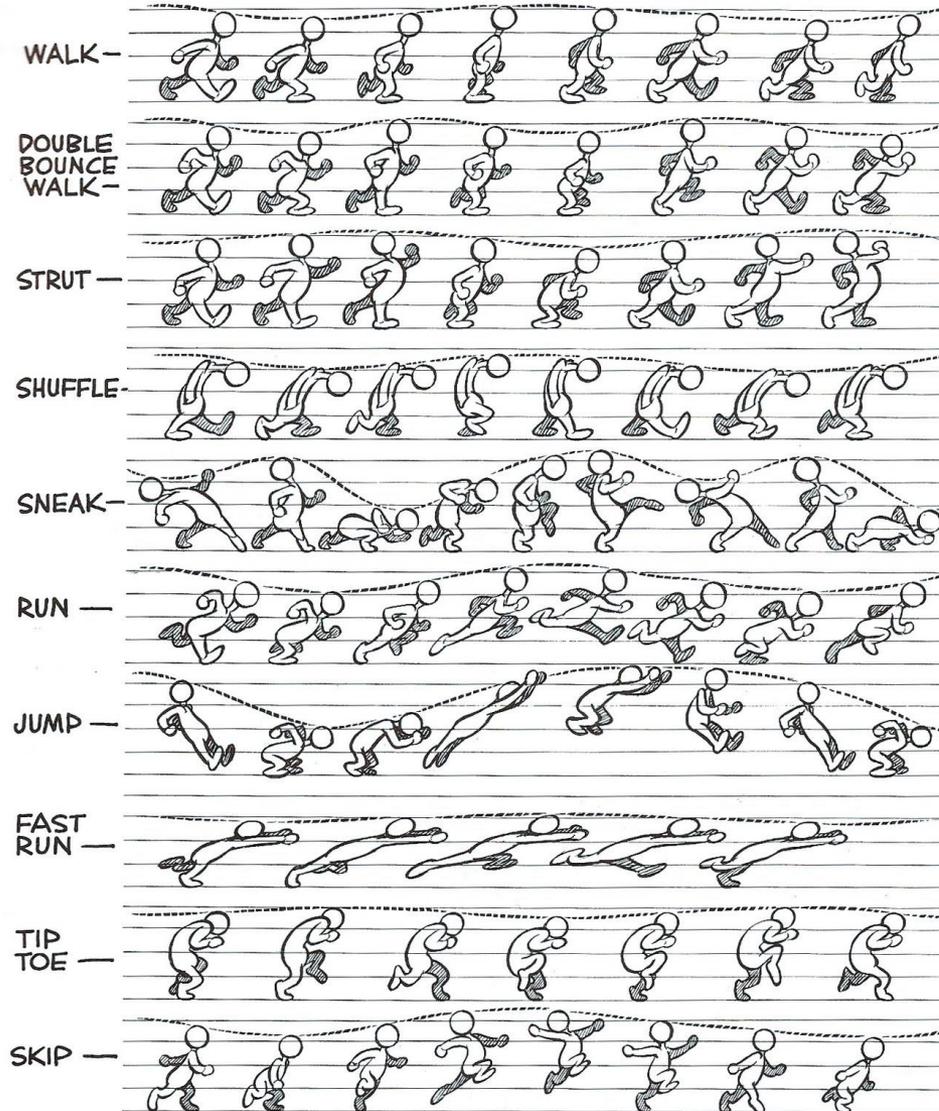
- This action adds to and enriches the main action and adds more dimension to the character animation, supplementing and/or re-enforcing the main action.
- Example: A character is angrily walking toward another character. The walk is forceful, aggressive, and forward leaning. The leg action is just short of a stomping walk. The secondary action is a few strong gestures of the arms working with the walk.
- Also, the possibility of dialogue being delivered at the same time with tilts and turns of the head to accentuate the walk and dialogue, but not so much as to distract from the walk action.
- All of these actions should work together in support of one another. Think of the walk as the primary action and arm swings, head bounce and all other actions of the body as secondary or supporting action.

Secondary Action



- Expertise in timing comes best with experience and personal experimentation, using the trial and error method in refining technique.
- The basics are: more drawings between poses slow and smooth the action. Fewer drawings make the action faster and crisper.
- A variety of slow and fast timing within a scene adds texture and interest to the movement.
- Most animation is done on twos (one drawing photographed on two frames of film) or on ones (one drawing photographed on each frame of film).
- There is timing in the acting of a character to establish mood, emotion, and reaction to another character or to a situation. Studying movement of actors and performers on stage and in films is useful when animating human or animal characters. This frame by frame examination of film footage will aid you in understanding timing for animation. This is a great way to learn from the others.

Timing



- Exaggeration is not extreme distortion of a drawing or extremely broad, violent action all the time.
- It's like a caricature of facial features, expressions, poses, attitudes and actions.
- Action traced from live action film can be accurate, but stiff and mechanical.
- In feature animation, a character must move more broadly to look natural.
- The same is true of facial expressions, but the action should not be as broad as in a short cartoon style.
- Exaggeration in a walk or an eye movement or even a head turn will give your film more appeal.

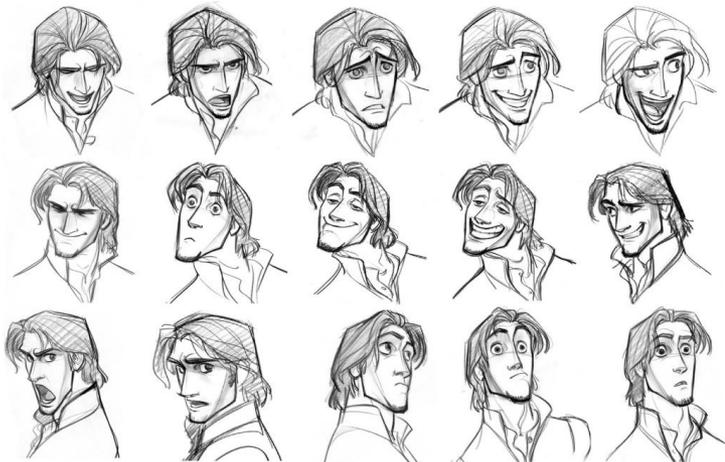
EXAGGERATION



- **The basic principles of drawing form, weight, volume solidity and the illusion of three dimension apply to animation as it does to academic drawing.**
- **The way you draw cartoons, you draw in the classical sense, using pencil sketches and drawings for reproduction of life. You transform these into color and movement giving the characters the illusion of three-and four-dimensional life.**
- **Three dimensional is movement in space.**
- **The fourth dimension is movement in time.**



- **A live performer has charisma. An animated character has appeal.**
- **Appealing animation does not mean just being cute and cuddly.**
- **All characters have to have appeal whether they are heroic, villainous, comic or cute.**
- **Appeal, as you will use it, includes an easy to read design, clear drawing, and personality development that will capture and involve the audience's interest.**
- **Early cartoons were basically a series of gags strung together on a main theme. Over the years, the artists have learned that to produce a feature there was a need for story continuity, character development and a higher quality of artwork throughout the entire production.**
- **Like all forms of story telling, the feature has to appeal to the mind as well as to the eye.**



2008
Disney • PIXAR

