Week 16:

Intro to Animation

File Edit Create Select Tools Mesh Animate Simulate Render MoGraph Character Plugins Script Window Help

View Cameras Display Options Filter Panel

View Cameras Display Options Filter Pan

View Cameras Display Options Filter Panel

View Cameras Display Options Filter Panel

Topics

History, goals and principles

Artist-driven animation: rigging, posing, keyframing

Procedural animation: physical simulation

Cloth simulation

Computer aids: forward & inverse kinematics

Data-driven animation: motion capture

Animation

"Bring things to life"

Communication tool
An extension of modeling
Represent scene models as a function of space
Output: sequence of images that when viewed sequentially provide a sense of motion

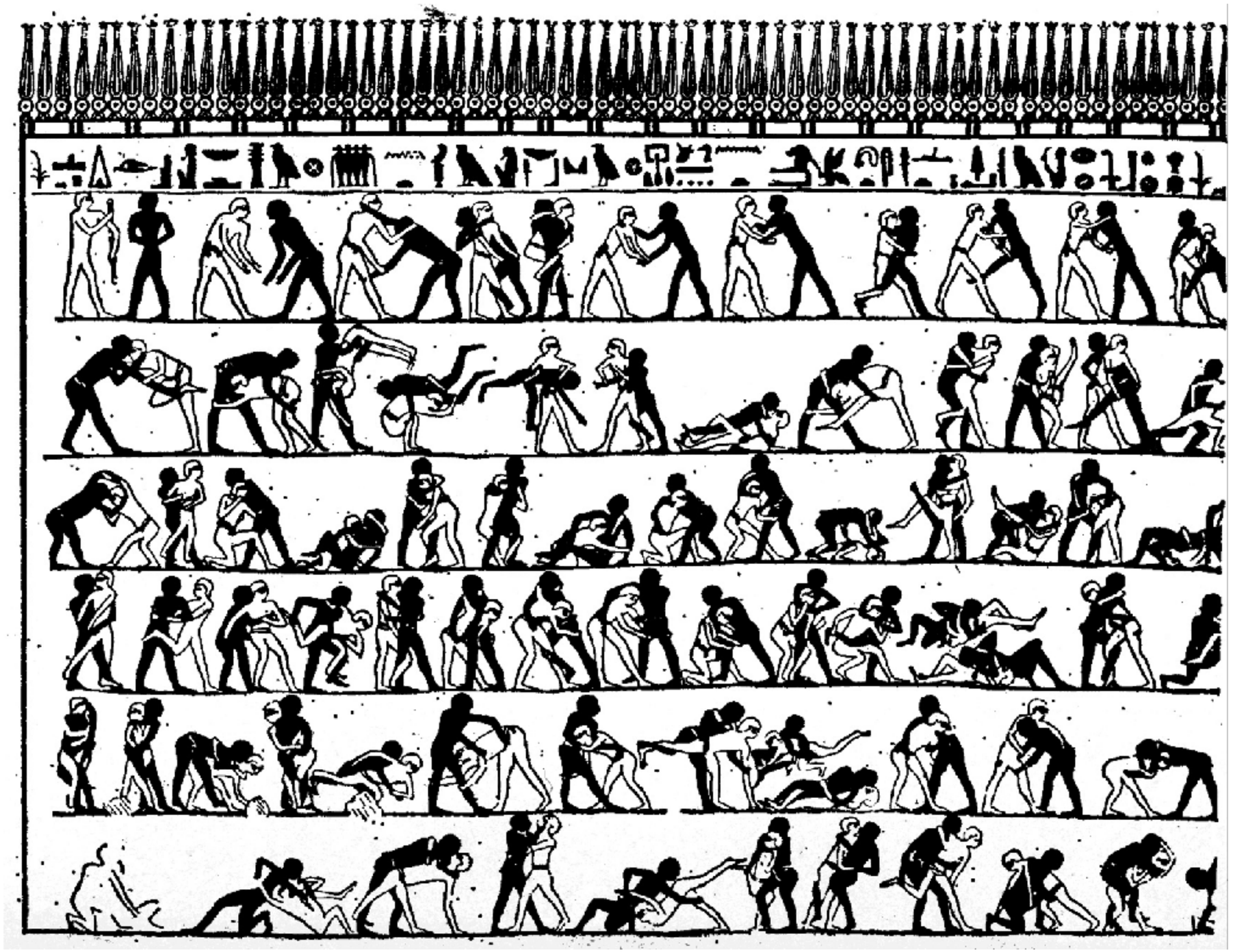
- Film: 24 frames per second
- Video: 30 fps
- Virtual reality: 90 fps

Historical Points in Animation

First Animation

(Shahr-e Sukhteh, Iran 3200 BCE)

History of Animation



(tomb of Khnumhotep, Egypt 2400 BCE)

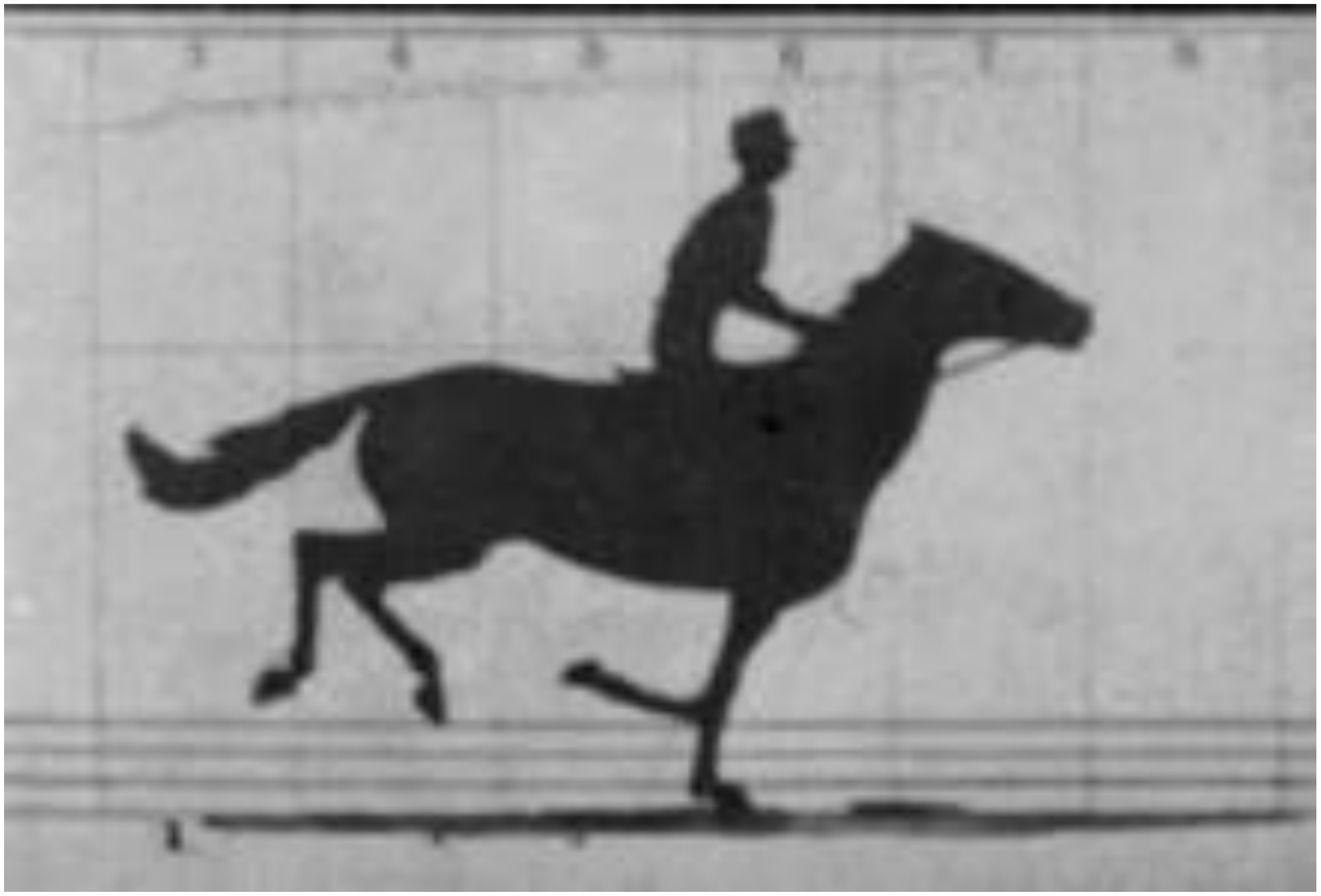
History of Animation

(Phenakistoscope, 1831)

First Film

Originally used as scientific tool rather than for entertainment

Critical technology that accelerated development of animation

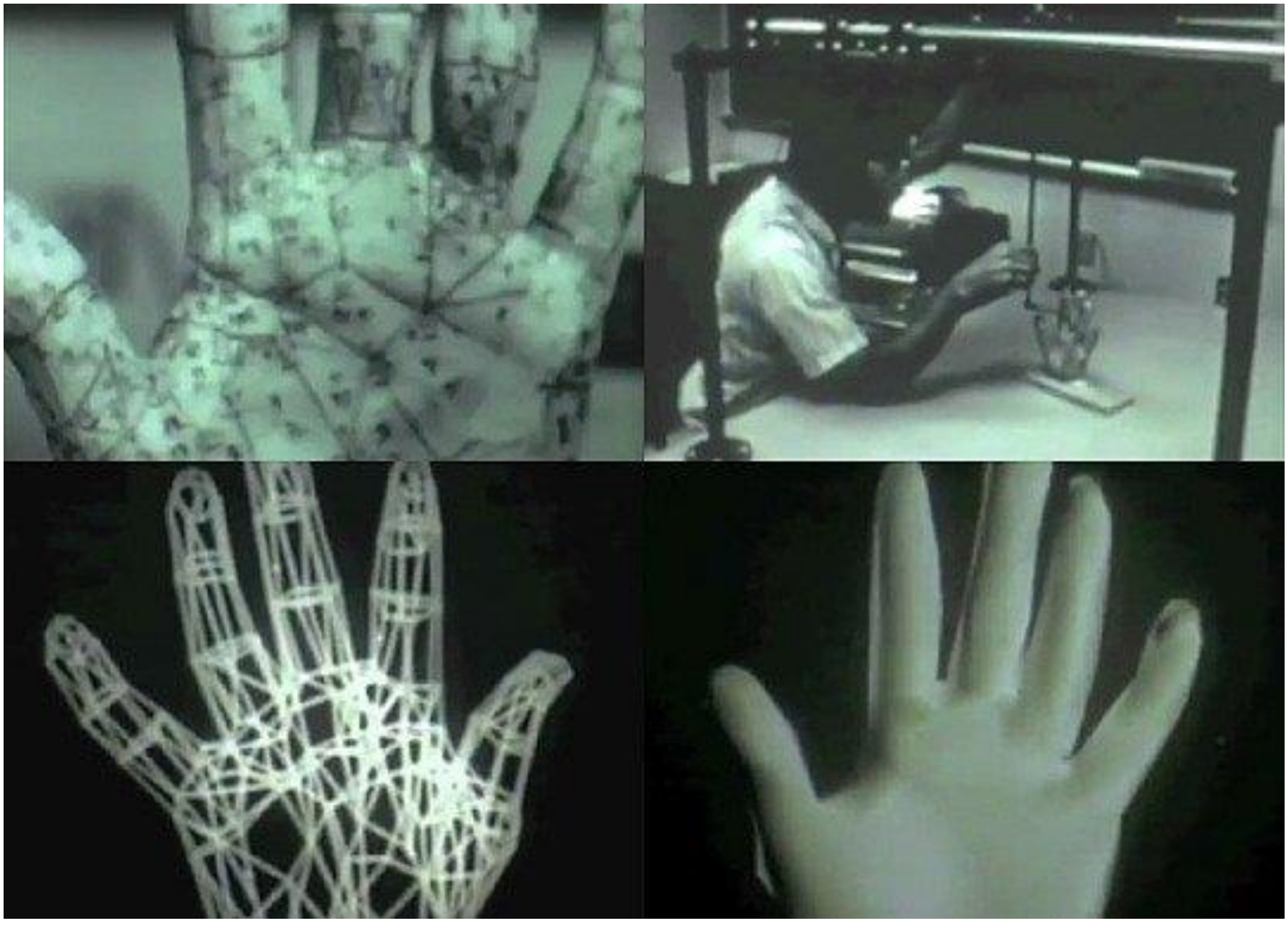


Edward Muybridge, *“Sallie Gardner”* (1878)

First Hand-Drawn Feature-Length Animation

Disney, “Snow White and the Seven Dwarfs” (1937)

Early Computer Animation



Ed Catmull & Frederick Parke, “Computer Animated Hand” (1972)

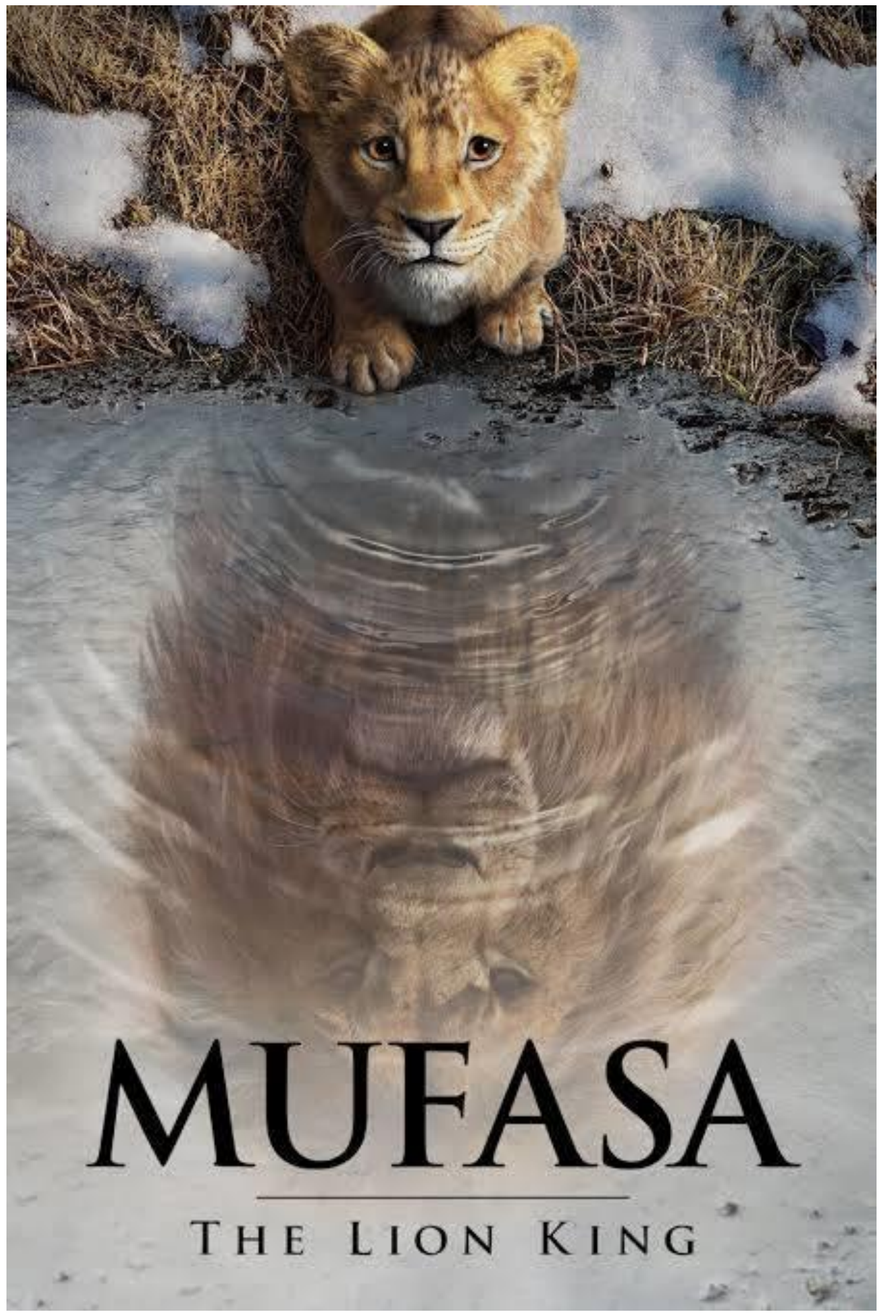
Digital Dinosaurs!

Jurassic Park (1993)

First CG Feature Film

Pixar, “Toy Story” (1995)

Computer Animation - Present Day



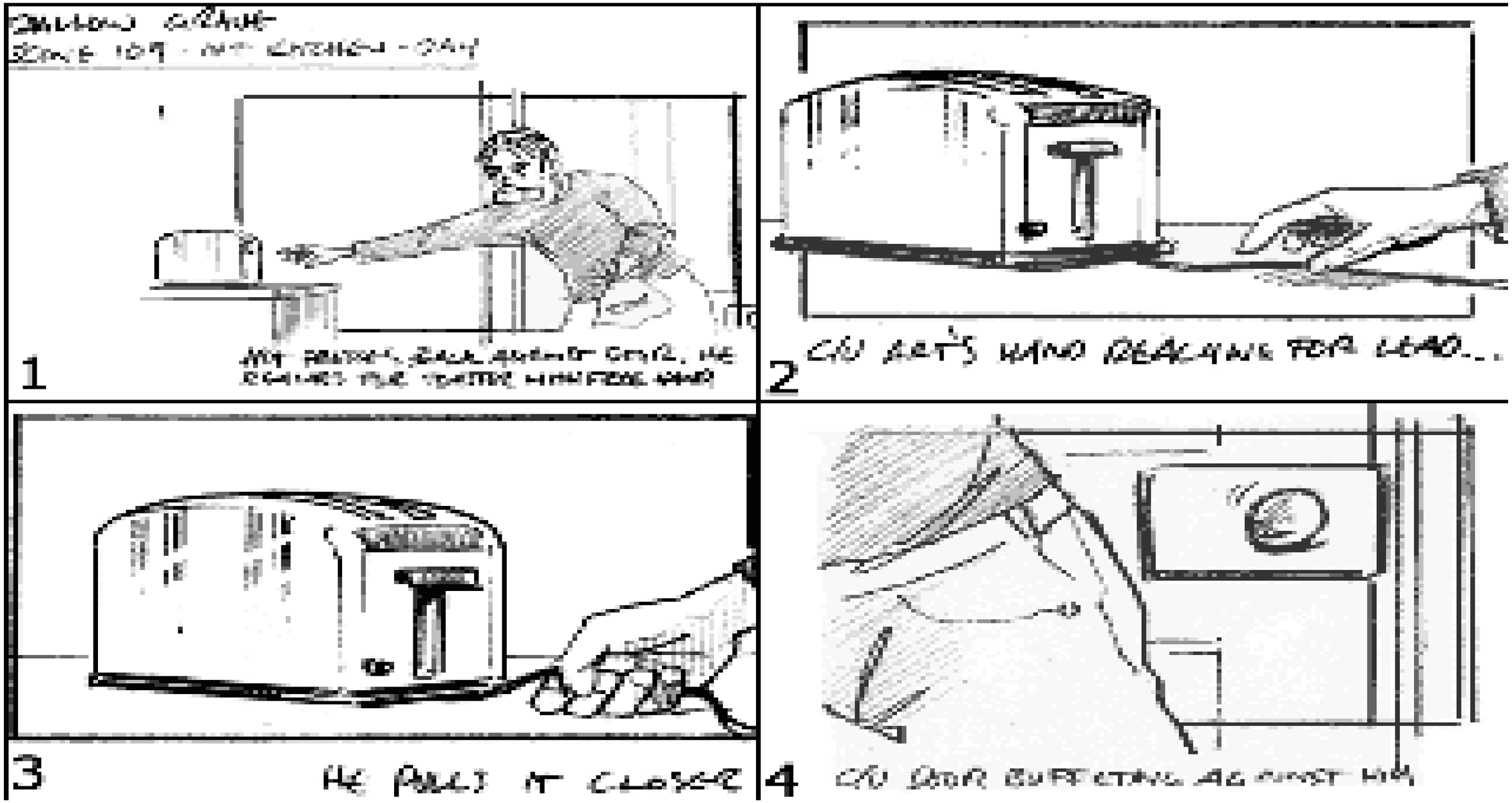
Walt Disney, “Mufasa” (2024)

Design Of Animation Sequences

• Steps for designing animation sequences.

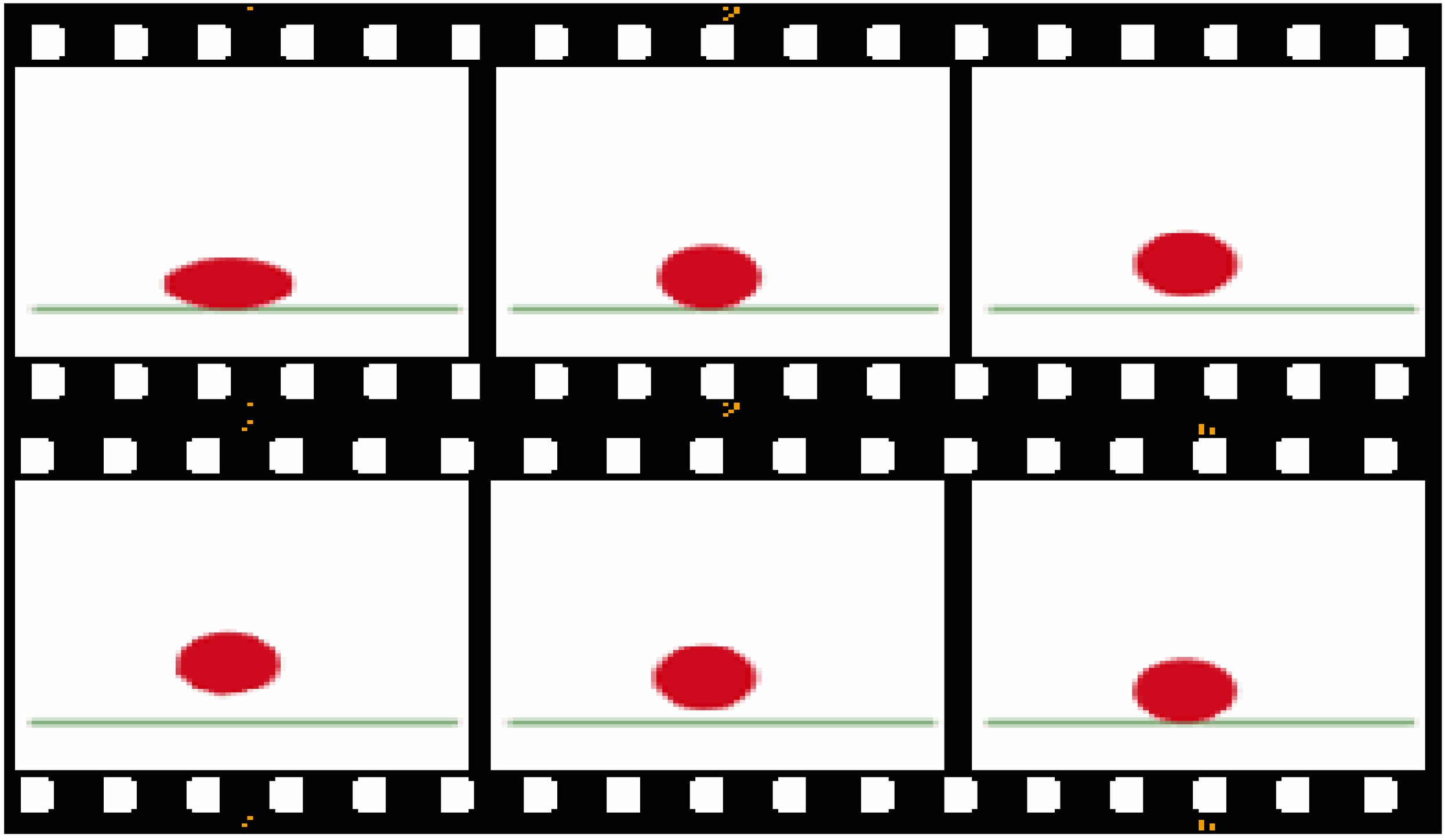
1. Storyboard Layout
2. Object definitions
3. Key frame specifications
4. Generation of in-between frames

Storyboard Layout

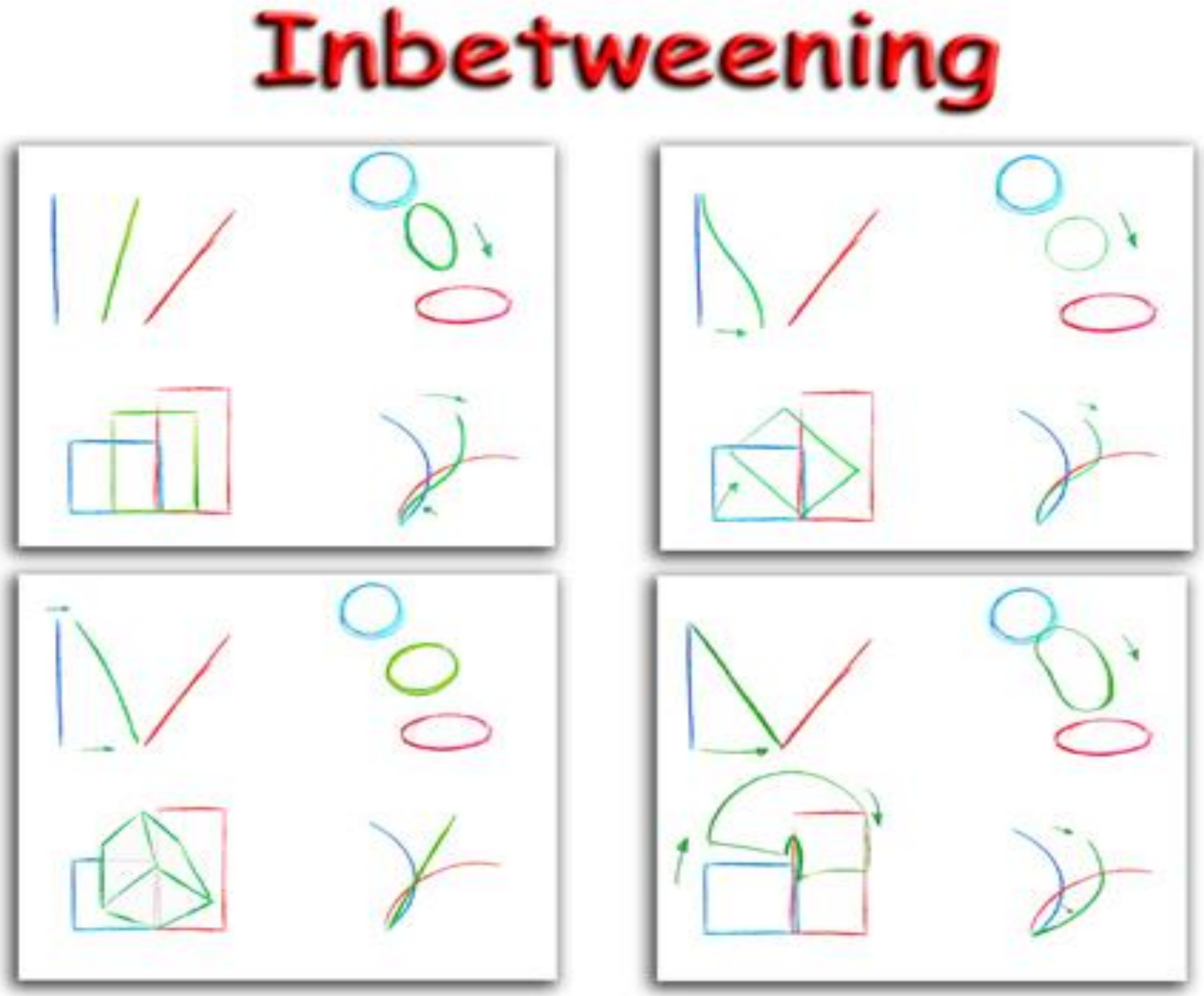


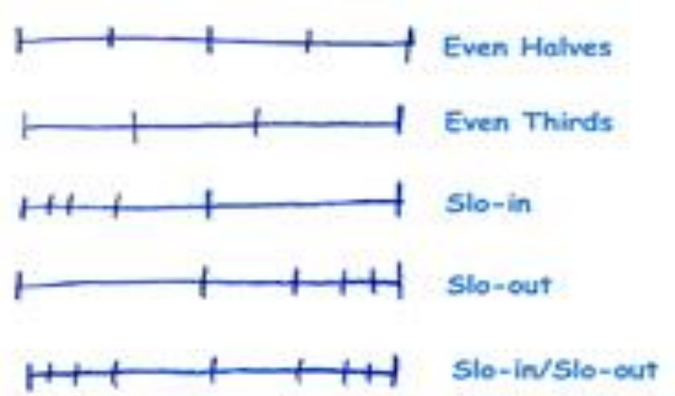
Object Definitions

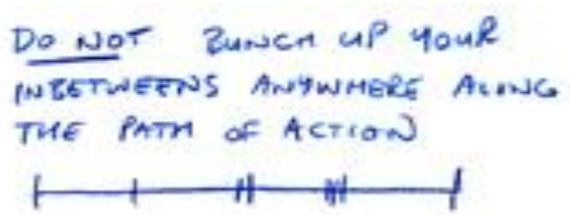
Key frame Specifications



In-between frames







Inbetweening is the fine art of knowing how and where to draw the line so that the action intended is clearly understood by the viewer. A good inbetween is not just half way between two lines.

Keyframe Animation

Keyframes

“Tweens”

Animator (e.g. lead animator) creates keyframes

Assistant (person or computer) creates in-between frames (“tweening”)

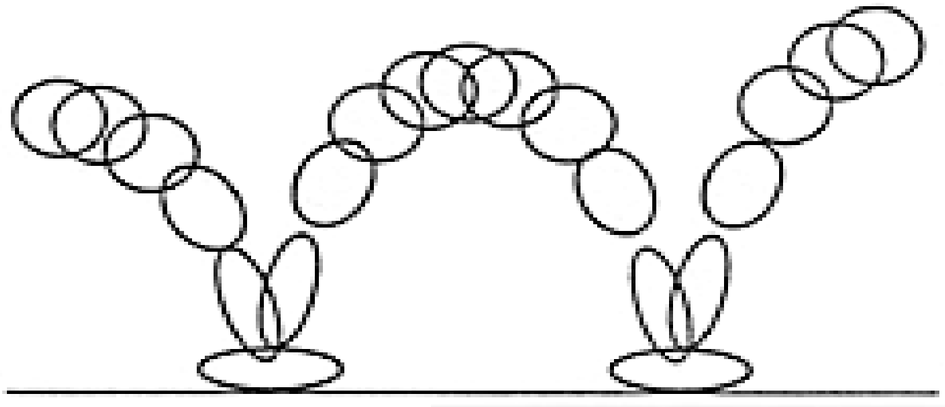
Animation Principles

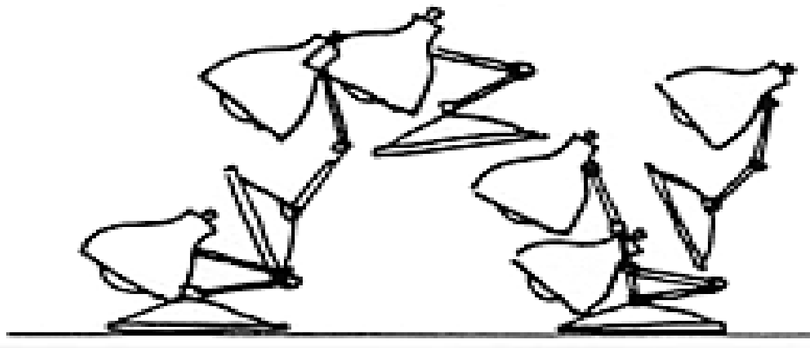
Squash and Stretch

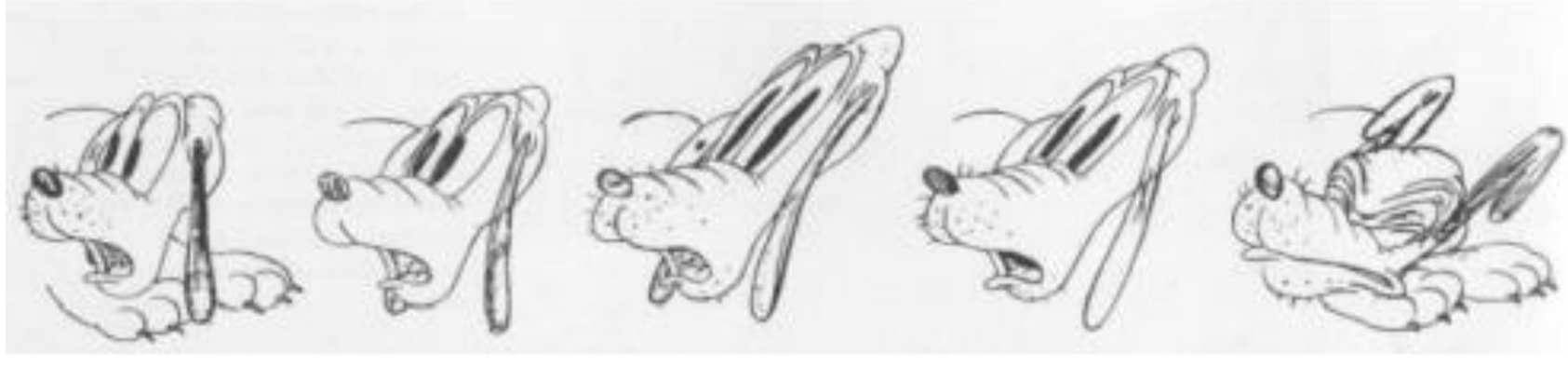
Refers to defining the rigidity and mass of an object by distorting its shape during an action.

Shape of object changes during movement, but not its volume.

Example: A bouncing ball squashes when it hits the ground and stretches when it moves fast through the air. Used subtly in characters to enhance expressiveness.







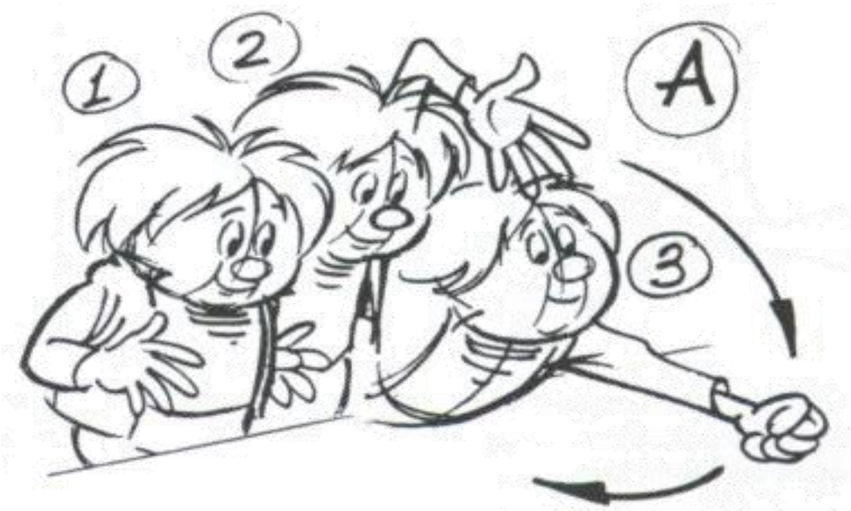
Anticipation

Prepare for each Movement/action

For physical realism

To prepare the audience for the next action and direct them attention to the certain part of the screen

Example: A baseball player pulls back the bat before swinging. It builds momentum and signals what's about to happen.



Timing for Animation, Whitaker & Halas

Staging

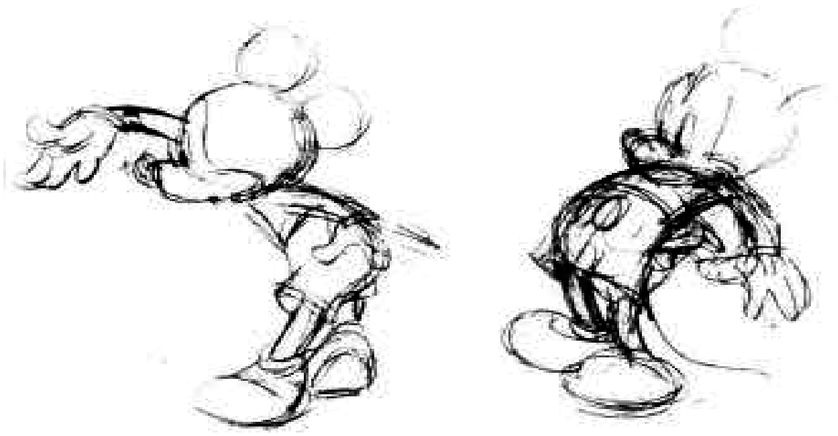
Picture is 2D

Make situation clear

Audience looking in right place

Action clear in silhouette

Example: Using lighting, composition, or character placement to highlight key movement or emotion.



Disney Animation: The Illusion of Life

Straight Ahead Action and Pose-to-Pose

Straight Ahead: Animate frame by frame from start to finish – more fluid and unpredictable.
Pose-to-Pose: Create key poses first, then fill in in-betweens – more controlled and planned.

Use: Often blended – straight ahead for organic motion, pose-to-pose for dramatic timing.

Follow Through

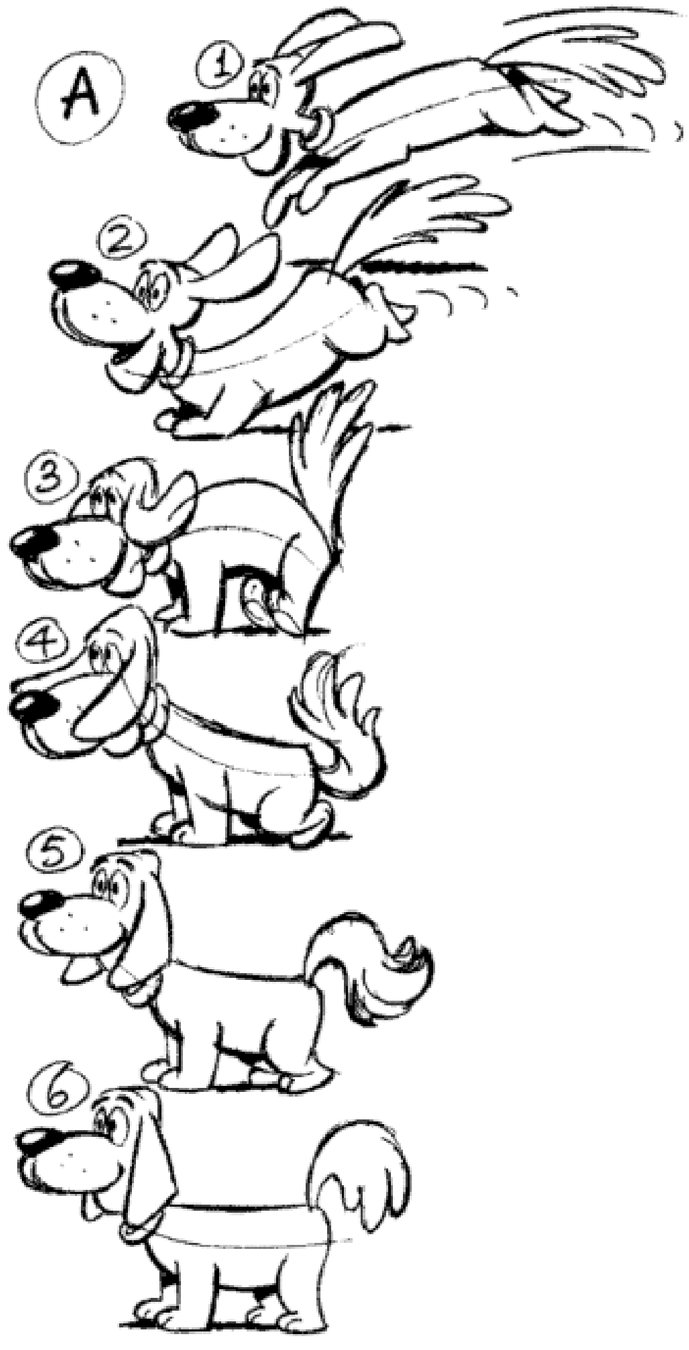
Overlapping motion

Termination of the action

Pieces continue at different rates

One motion starts while previous is finishing, keeps animation smooth

Adds realism and fluidity.



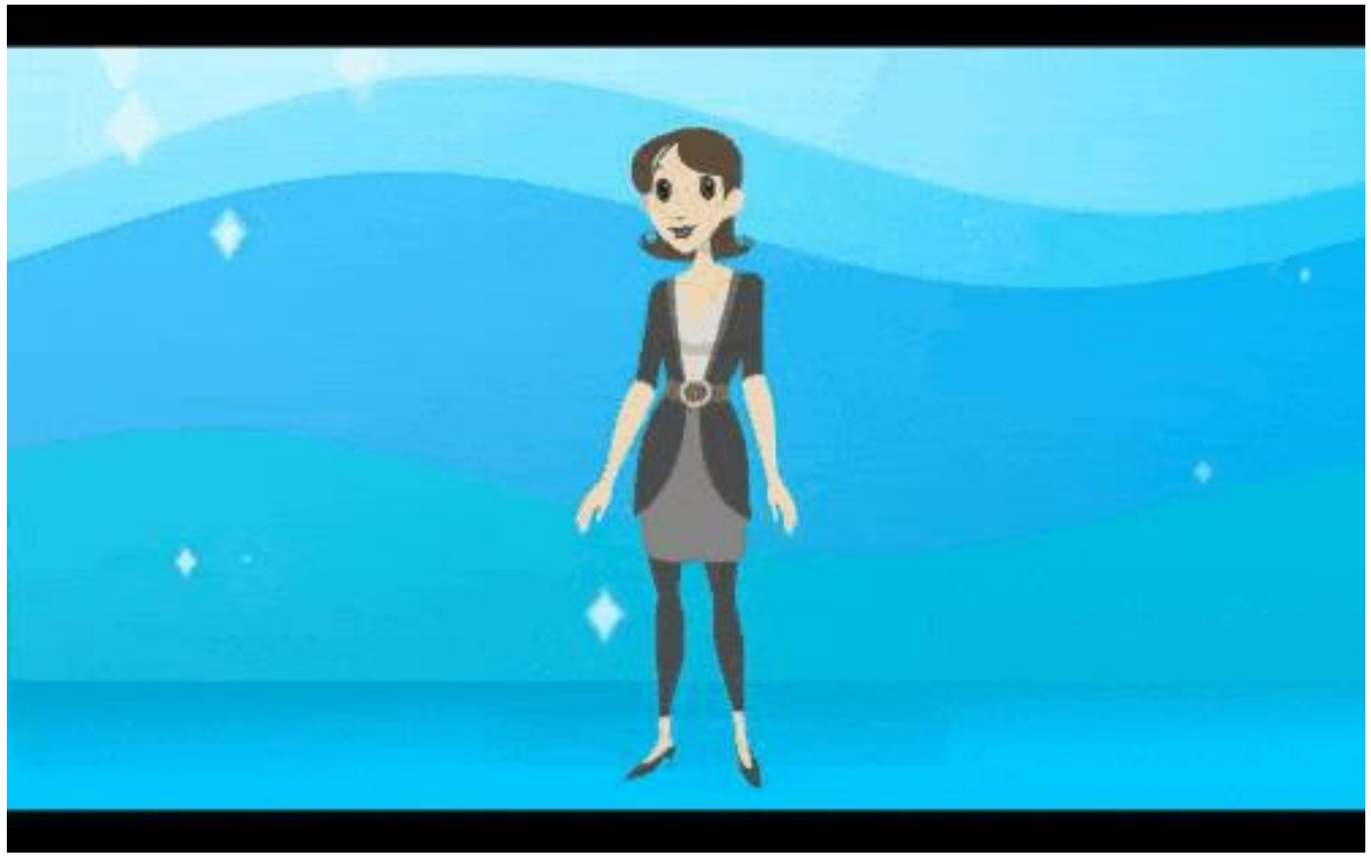
Timing for Animation, Whitaker & Halas

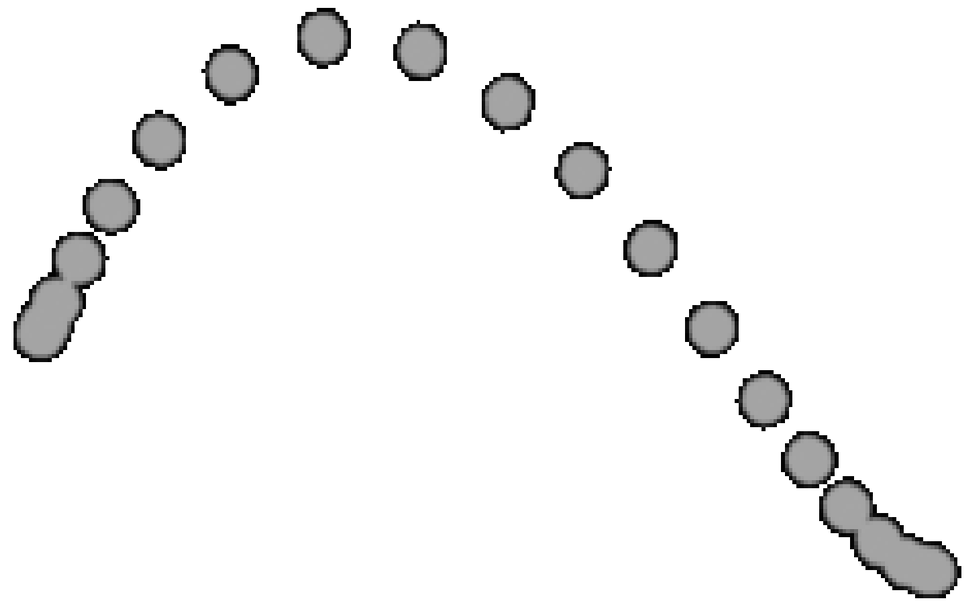
Ease-In and Ease-Out

Movement doesn’t start & stop abruptly.

Also contributes to weight and emotion

Example: A car doesn’t go from 0 to 60 instantly—neither should animated motion.



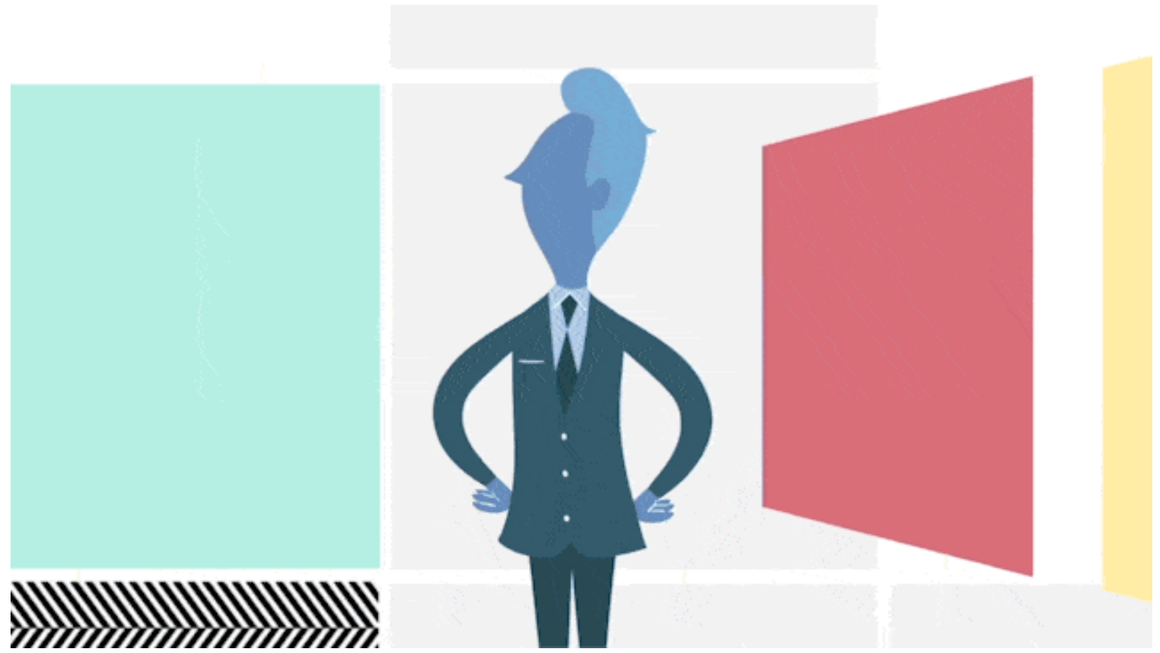


Arcs

Move in curves, not in straight lines

This is how living creatures move

Example: A swinging arm or bouncing ball follows an arc, which looks more lifelike and smoother.



Secondary Action

Motion that results from some other action

Needed for interest and realism

Shouldn’t distract from primary motion

Example: A character walking (primary) while whistling or swinging arms (secondary). It enhances emotion and storytelling.

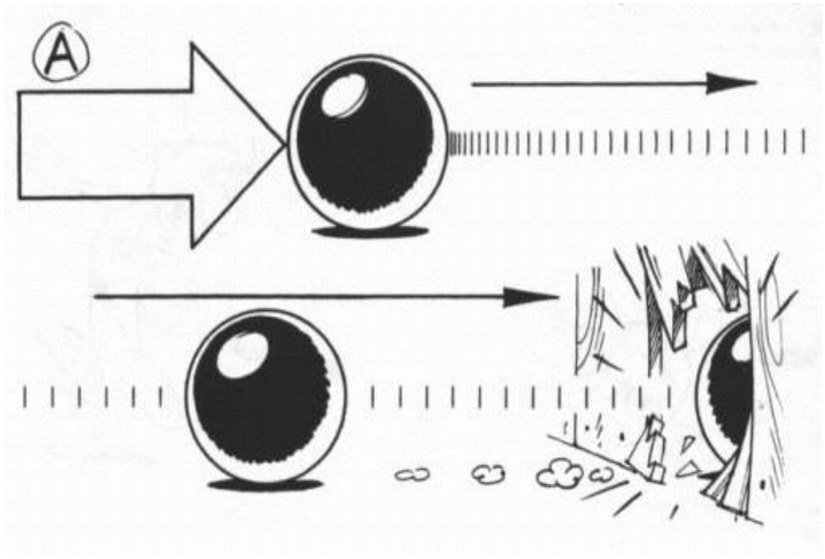
A deer takes a bite of a leaf sprayed with DeerPro repellant. The primary action is the deer spitting out the leaf when he realizes it’s no good. The secondary action is the slight tail wag that shows the deer’s relief to have the awful taste out of his mouth.

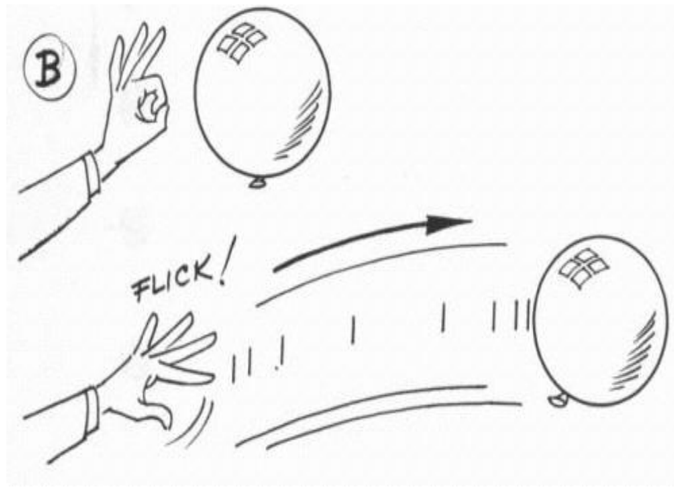
Timing

Rate of acceleration conveys weight

Speed and acceleration of character's movements convey emotion

Example: Fewer frames = fast action (excitement), more frames = slow action (sadness or heaviness).





Timing for Animation, Whitaker & Halas

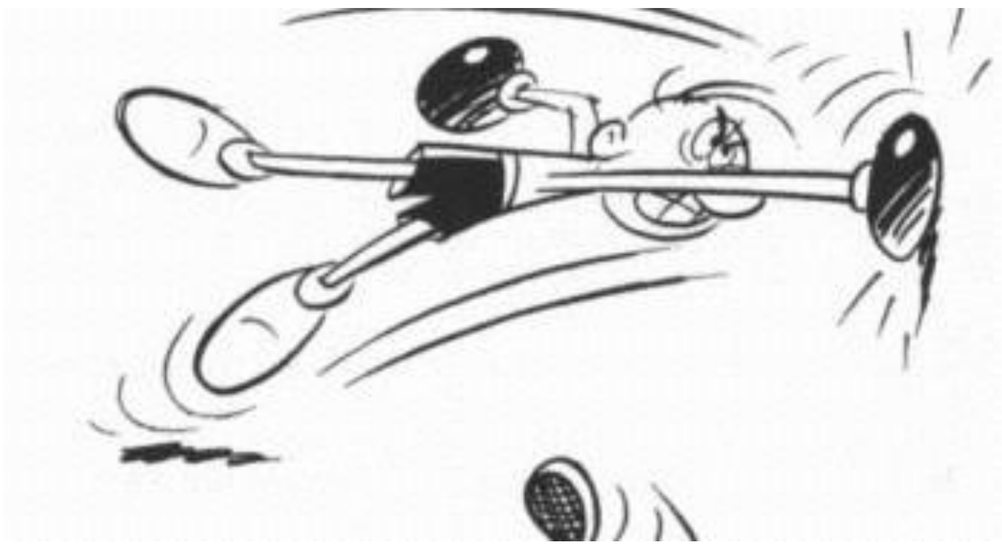
Exaggeration

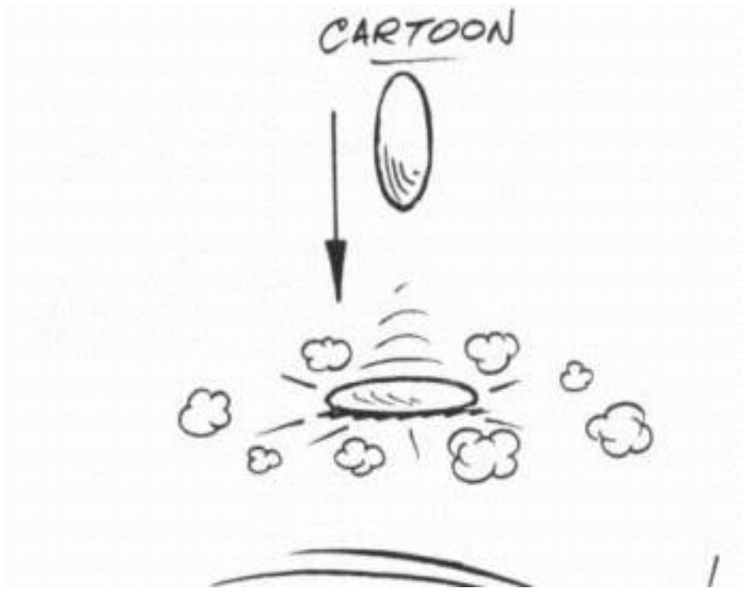
Helps make actions clear

Helps emphasize story points and emotion

Must balance with non-exaggerated parts

Example: A surprised character's jaw drops further than in real life, or a jump is extra high for comedic effect.



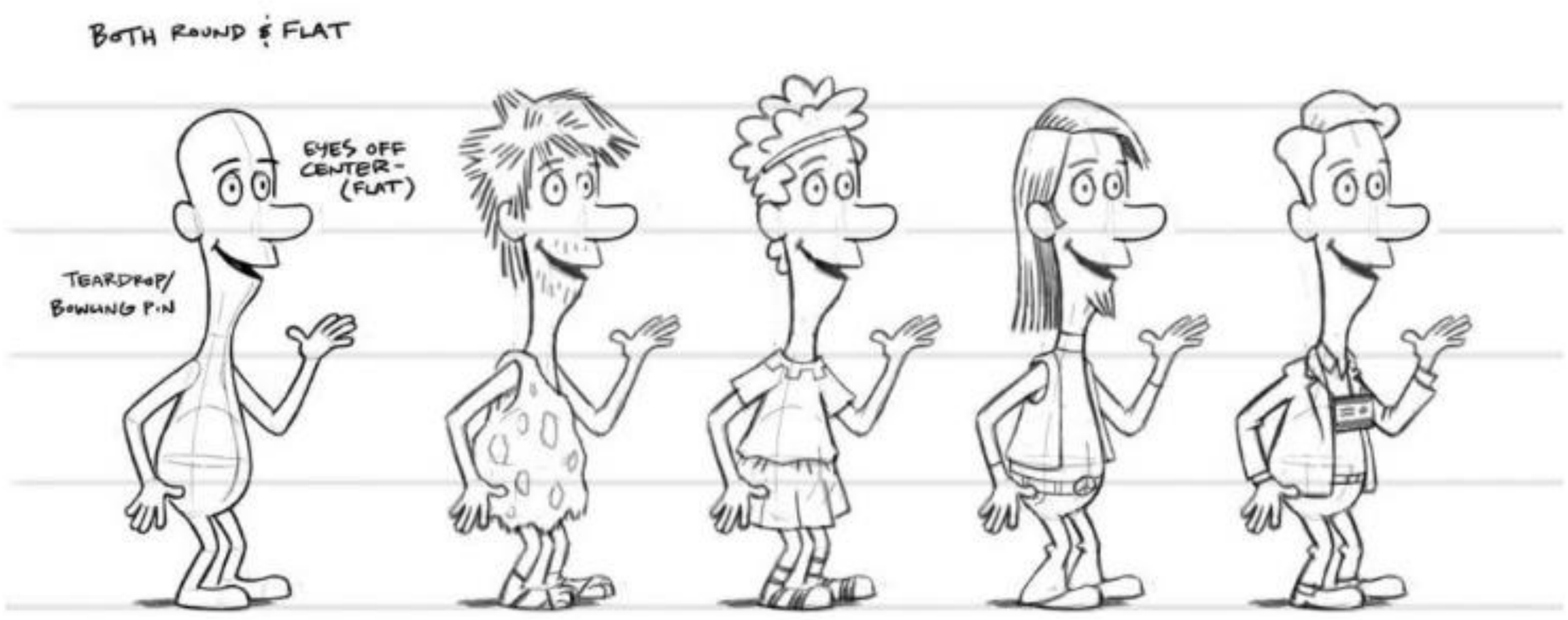


Timing for Animation, Whitaker & Halas

Solid Drawing

- Drawings must convey volume, weight, and balance—even in stylized designs.

Example: Understanding anatomy, perspective, and 3D space helps create believable characters.



Appeal

Attractive to the eye, strong design

Avoid symmetries

Disney Animation: The Illusion of Life

12 Animation Principles

1. Squash and stretch
2. Anticipation
3. Staging
4. Straight ahead and pose-to-pose
5. Follow through
6. Ease-in and ease-out
7. Arcs
8. Secondary action
9. Timing
10. Exaggeration
11. Solid drawings
12. Appeal

12 Animation Principles

Cento Lodgiani, https://vimeo.com/93206523

12 Animation Principles

Applications:

- Movies
- Games
- User interfaces
- ...