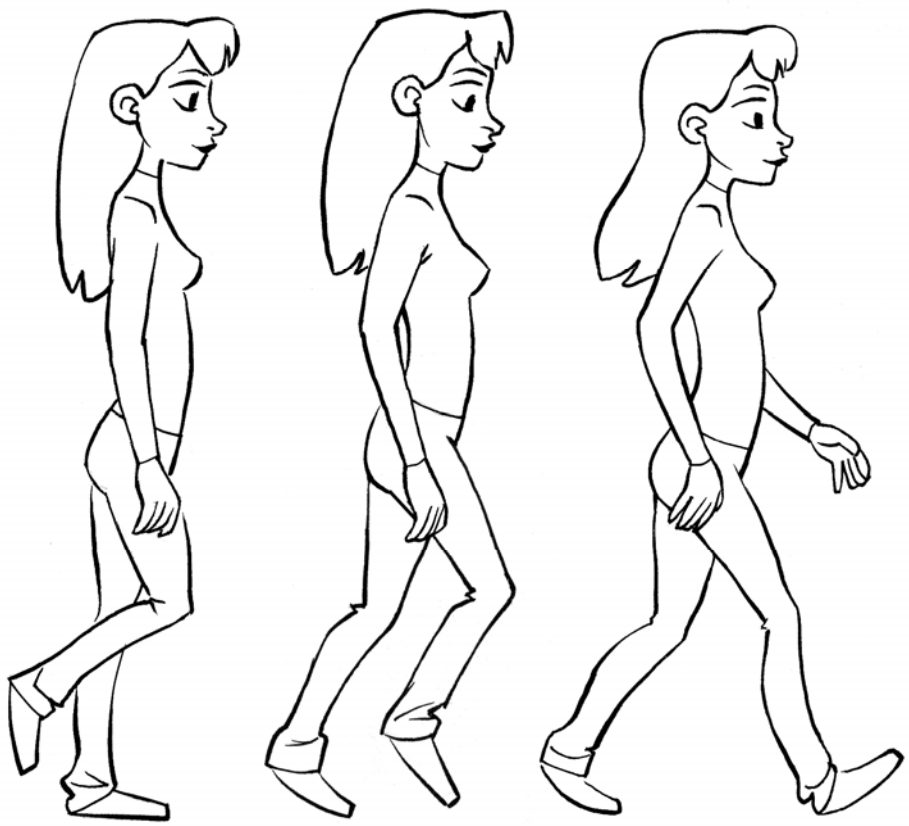
Intro to Falling

Animation
Physics

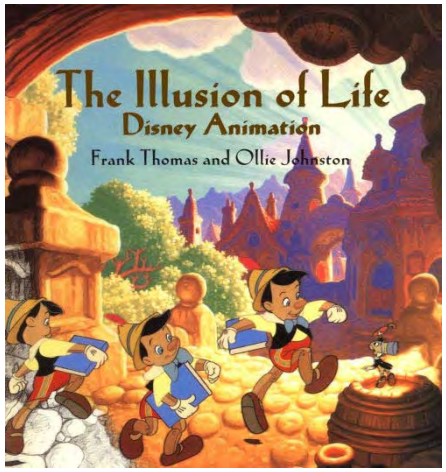
It’s all in the timing…

An essential element of animation is the timing and spacing between drawings



“It’s not important what goes on each frame of film; it’s the spaces between the frames that are important.“
Norman McLaren
Oscar winning animator of *Neighbors*

Principles of Animation



In *The Illusion of Life*, Frank Thomas and Ollie Johnston list a set of basic principles for animation.

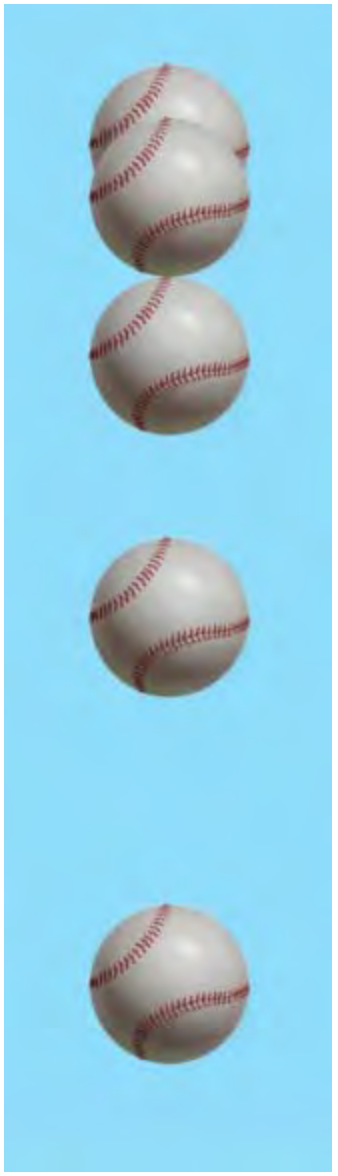
1. Squash & Stretch
2. Timing
3. Anticipation
4. Staging
5. Follow Through & Overlapping Action
6. Straight Ahead & Pose-to-Pose Action
7. Slow In & Slow Out
8. Arcs
9. Exaggeration
10. Secondary Action
11. Appeal
12. Solid Drawing

Ball Drop Animation Exercise

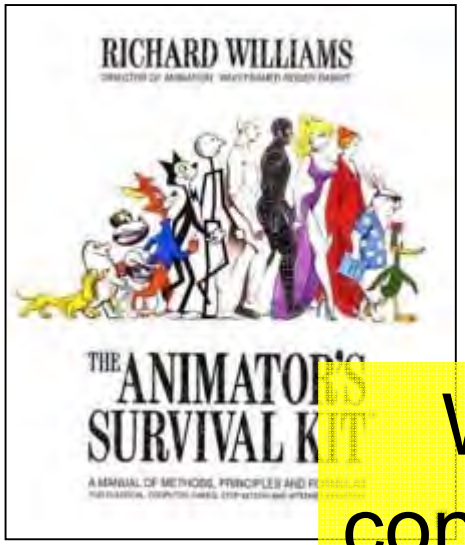
We'll start with timing and spacing for falling motion, such as a falling baseball.

In this case, the drawing is the same round ball on every frame.

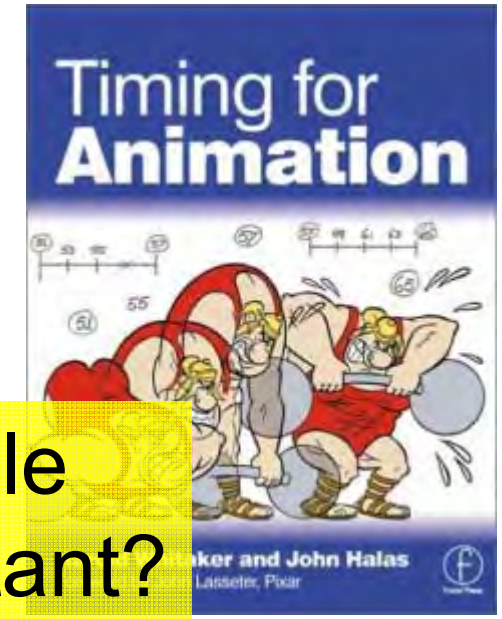
To animate the ball so that it moves realistically you need to know *where* the ball should be on each frame.



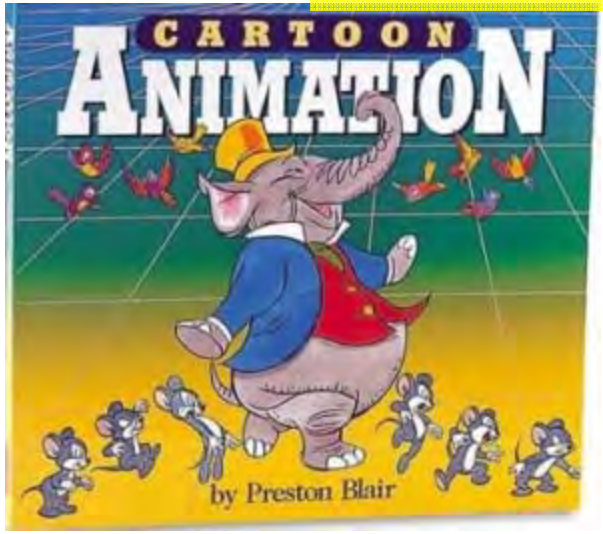
Ball Drop in Animation Books

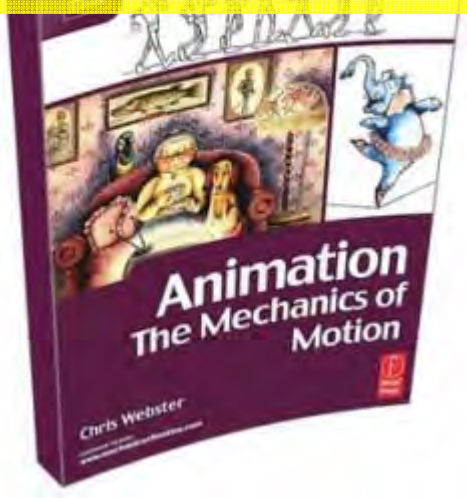


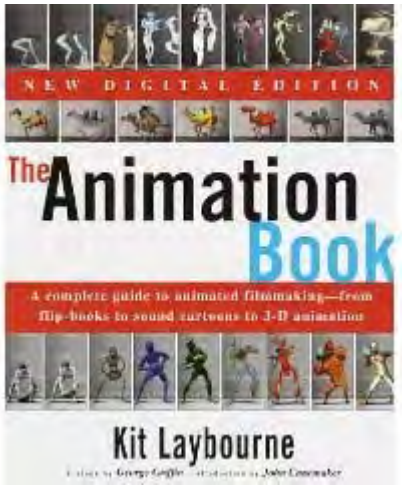
The ball drop is discussed in every major textbook for animation.



Why is this example considered so important?

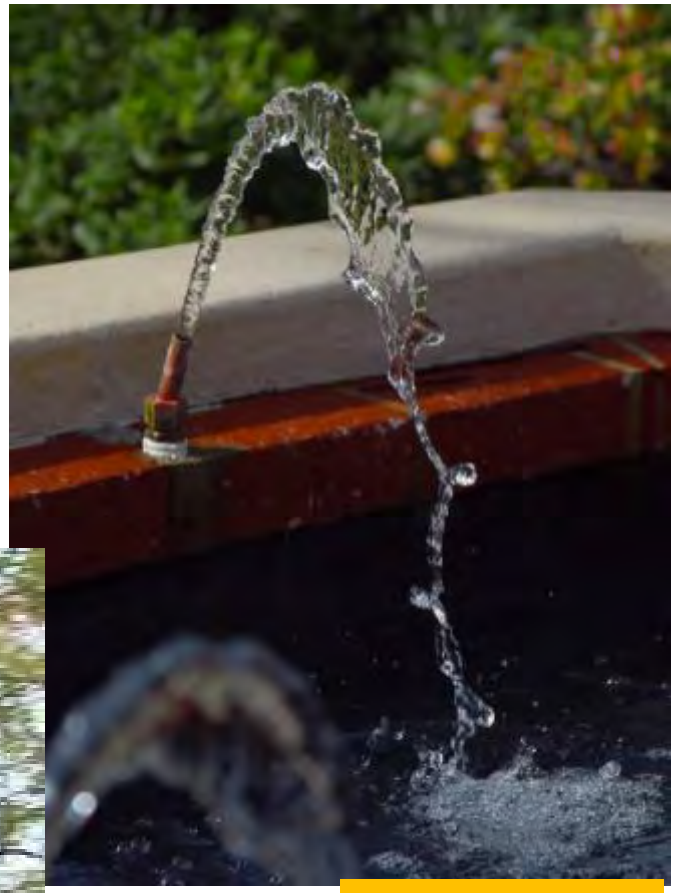




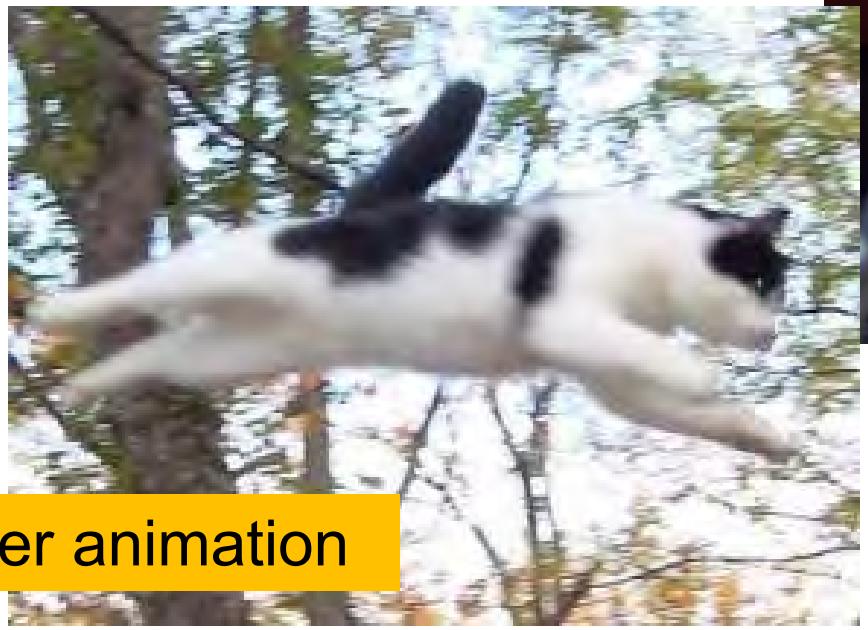


Principle of Timing and Spacing

The principle of timing and spacing used to create a believable ball drop applies to many other types of animated motion.



Effects animation



Character animation

Timing: Frames, Keys, & Clocks

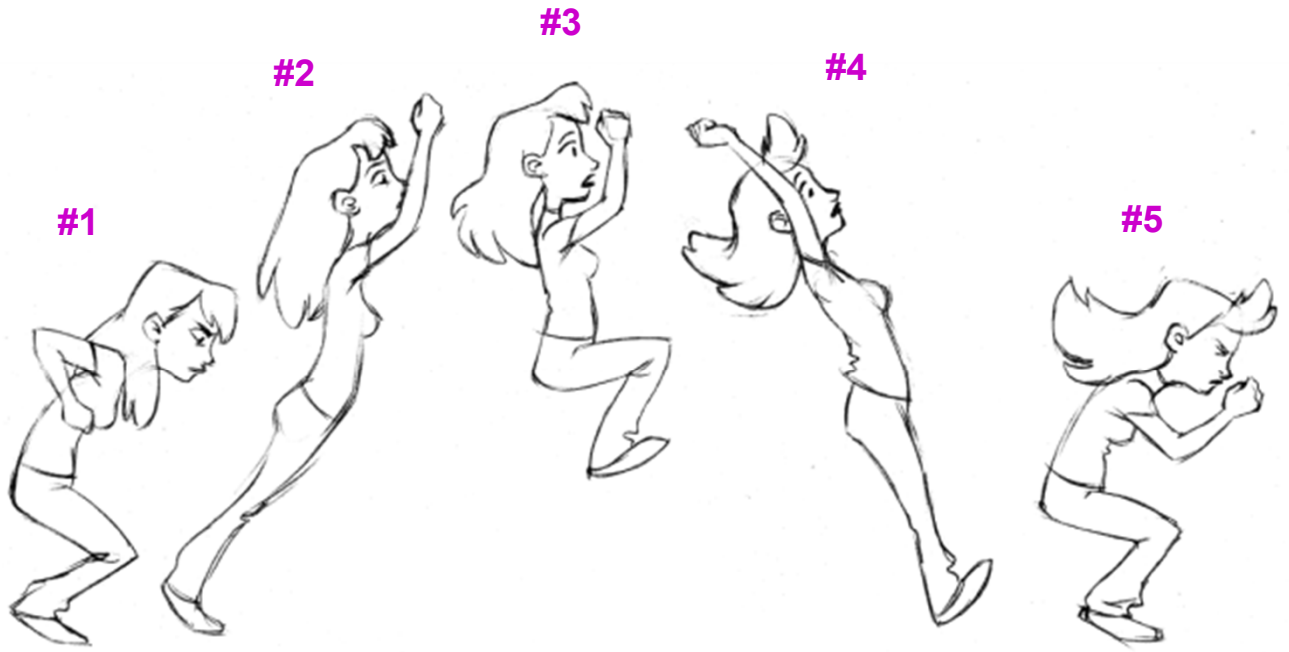
Animators measure time in different ways:

- Frames (intervals of 1/24th of a second)
- Keys (given number of frames between poses)
- Clocks (actual seconds as measured by a clock)

Animators typically use all of these. They might use a stopwatch to plan the length of a shot then convert that into a frames count and then decide on how many keys they will put in that shot.

Frames between Keys

Here are the key poses in a jump with the drawings “shot on threes”, that is, three frames per drawing.



IMPORTANT: For simplicity, in all our examples the key poses will always have an equal number of frames between each key.

Frames per Second (FPS)

Frame rate is measured in frames per second (FPS). Two common frame rates:

24 FPS – Used in film
30 FPS – Used in video

We will always use 24 FPS in our examples and convert to video frame rate if needed.

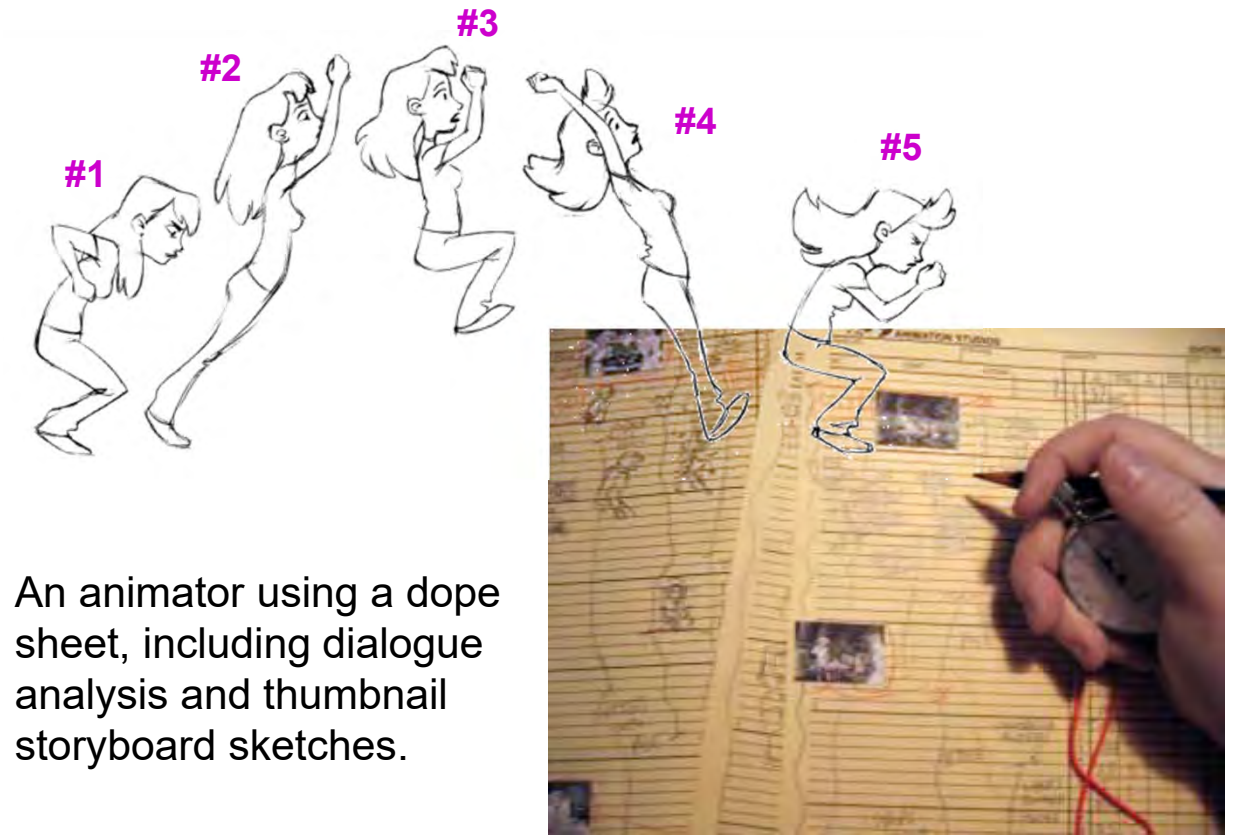
(4 Frames of Film) = (5 Frames of Video)

Dope Sheets

Dope sheets (also called exposure sheets or X-sheets) are used by animators to tabulate which drawing (or pose) goes on which frame.

Dope Sheet

Frame	Key
1	#1
2	|
3	|
4	#2
5	|
6	|
7	#3
8	|



An animator using a dope sheet, including dialogue analysis and thumbnail storyboard sketches.

Planning the Scene

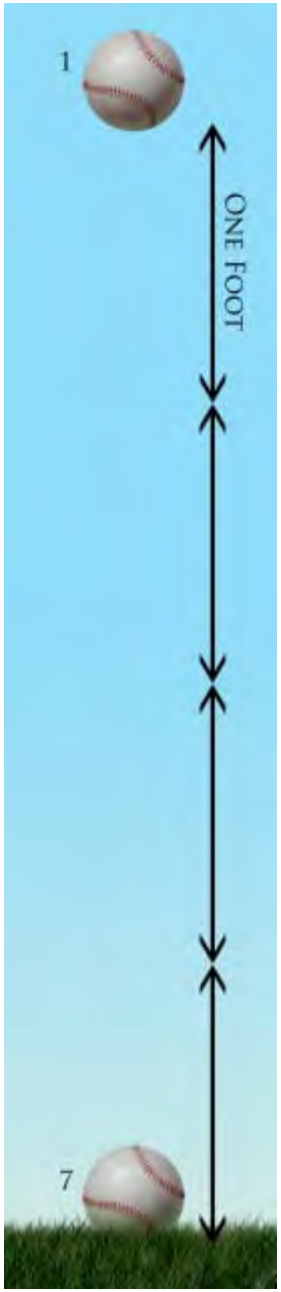
For a ball drop from a height of 4 feet it takes 12 frames from the apex to the ground.

“Shooting on twos” the dope sheet is this →

Key #1 is the apex

Key #7 is the ground

Frame	Key
1	#1
2	/
3	#2
4	/
5	#3
6	/
7	#4
8	/
9	#5
10	/
11	#6
12	/
13	#7

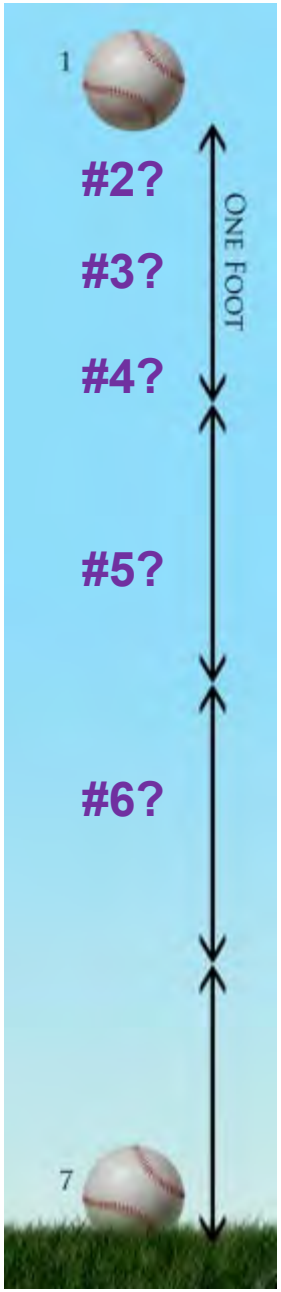


Planning the Scene

Where should the ball be on keys #2 through #6?

The next few videos explain how to create a believable ball drop in both traditional (cel) and computer (CG) animation.

Frame	Key
1	#1
2	/
3	#2
4	/
5	#3
6	/
7	#4
8	/
9	#5
10	/
11	#6
12	/
13	#7



Summary

- Falling motion is an important, basic exercise for learning animation.
- Timing and spacing define motion.
- Time may be measured in frames, keys, or seconds on a clock.
- Creating believable spacings for falling motion is explained in the next videos.