

Design Course

Principles of Animation

The 12 Fundamentals

by

Prof. Phani Tetali with Vajra Pancharia, Rohit

Kelkar and Shyam Wanare

IDC, IIT Bombay

Source:

<https://dsource.in/course/principles-animation>



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3. Anticipation
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5. Straight Ahead Animation
6. Pose to Pose Animation
7. Follow Through and Overlapping.....
8. Slow In Slow Out
9. Secondary Action
10. Timing
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<https://dsource.in/course/principles-animation/introduction>

Introduction

Traditional animation and Computer generated animation both have their own charm. Though the technicalities are a bit different; their core fundamental principles remain the same.

The principles of animation were introduced by the Disney animators to understand movement and create believable animations. Analyzing real action derived these principles, as imitating real life action became important for the development of animation. There are no strict rules, but the tools; which aid in better understanding of the 'animation'. It helps in giving a very simple motion – 'a life' and enhances its feel.

The following are the 12 main Principles of Animation:

1. Squash and stretch
2. Anticipation
3. Staging
4. Straight ahead action and pose to pose
5. Follow through and overlapping action
6. Ease in and Ease out
7. Arcs
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<https://dsource.in/course/principles-animation/squash-and-stretch>

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Squash and Stretch

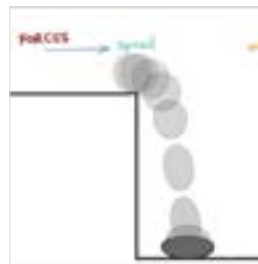
A way of deforming an object to show its rigidity or flexibility is Squash and stretch.

For Example:

A rubber ball tends to flatten if it bounces and hits the ground – A Squash Principle. The ball will ‘Stretch’ in the direction it’s going once it starts bouncing upwards again.

Squash and stretch help in bringing flexibility, sense of weight and volume in the animation adding more life and energy in the motion.

Below are the 3 examples given following the Squash and stretch principle.



Ball Bouncing Example



Water Balloon Example



Facial Expression Example



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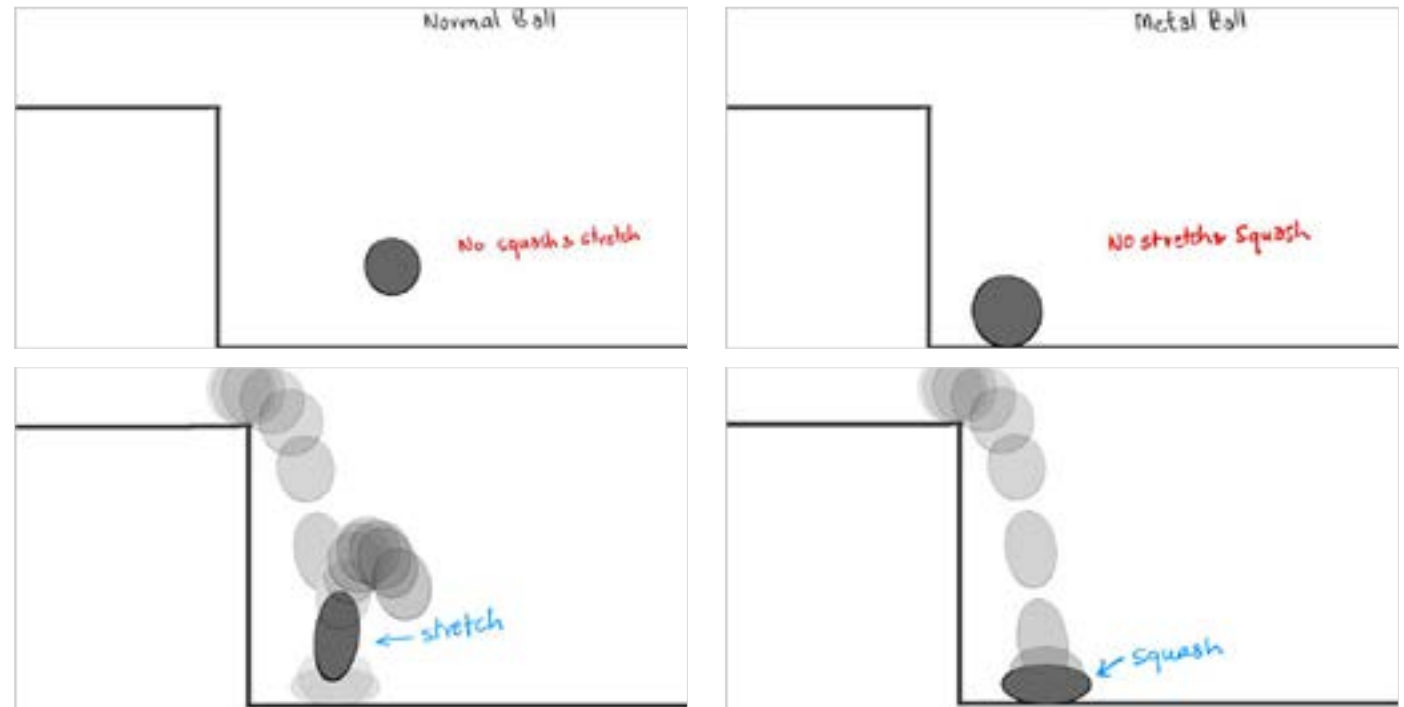
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<https://dsource.in/course/principles-animation/squash-and-stretch/ball-bouncing-example>

Ball Bouncing Example

In the example below a normal ball won't have much of squash and stretch as compared to a rubber ball because the weight and materials are different. Similarly, in the case of a metal ball; there won't be any stretch and squash as the ball is very heavy and it falls without any squash. Thus, squash and stretch also help in defining the material of the object by its visual appearance.



Also, there are forces that apply to the object. In the below example, the ball doesn't bounce by itself but there are forces that act upon the ball. Like Gravity that pulls the ball down and as the ball is stopped abruptly by a surface it squashes. Speed also plays an important role as the ball catches speed since gravity pulls it down. The ball tends to stretch in the direction it is going.

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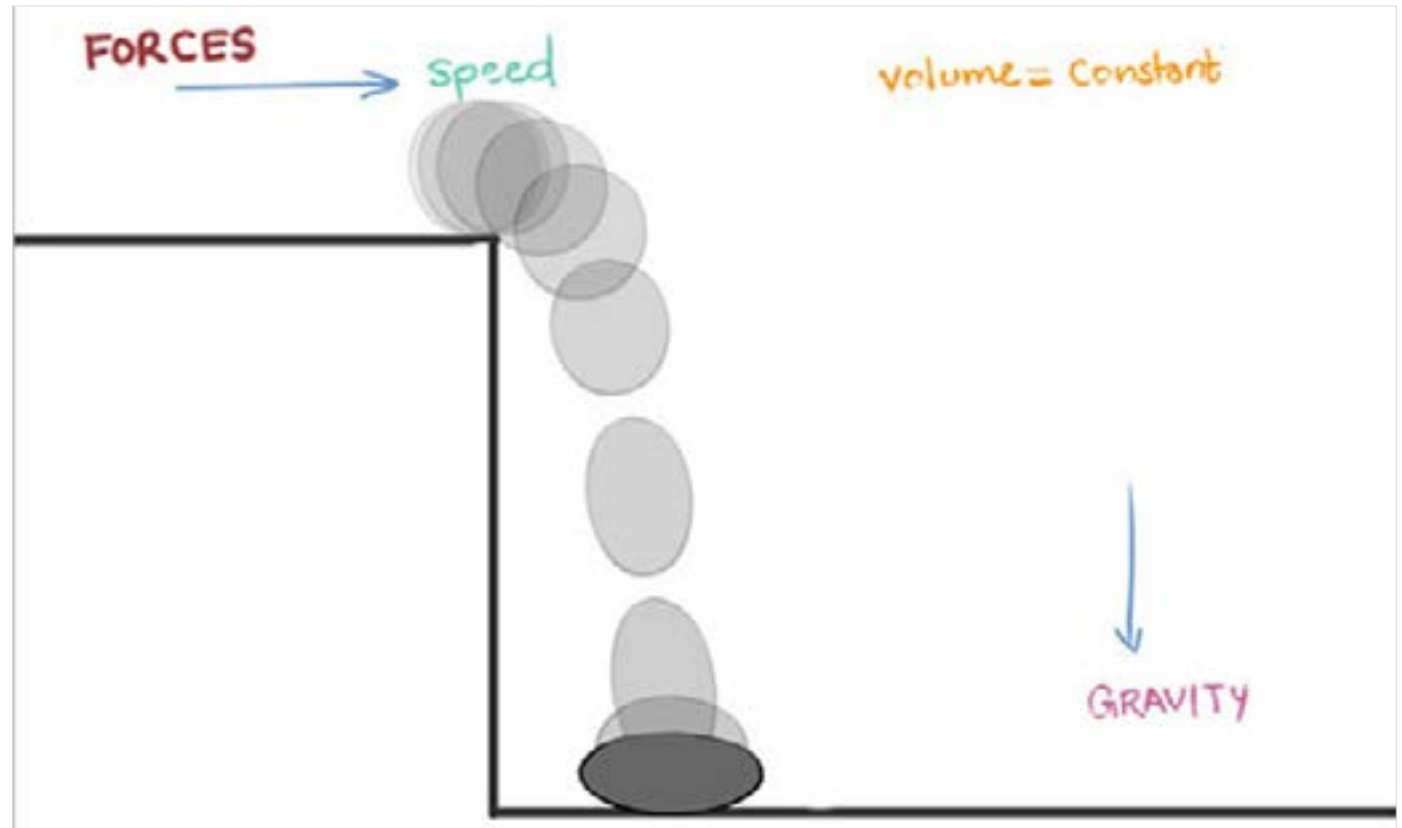
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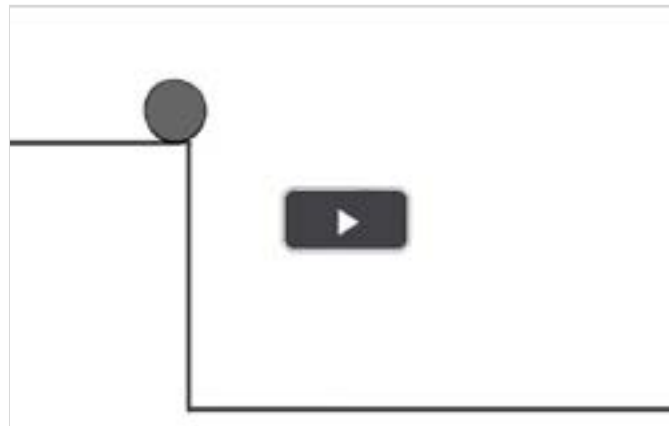
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Kindly refer to the videos for detailed process:



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Exercise:

For practicing stretch and squash it's better to try animating a bouncing ball and apply the principle to understand how stretch and squash work.

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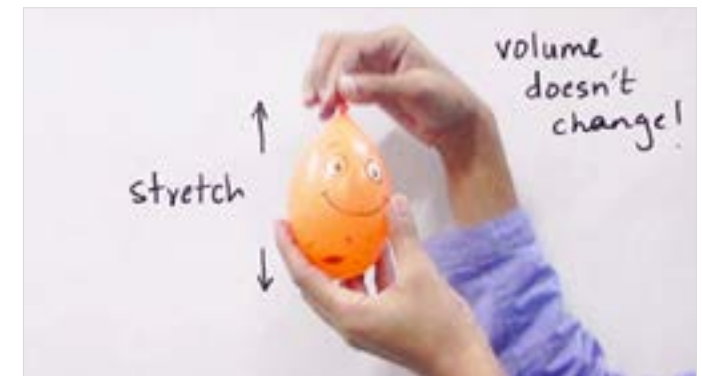
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Water Balloon Example

An important thing to note in squash and stretch is that the volume of the object is retained i.e. it doesn't get changed even if the object is deformed.

For Example:

A water balloon in the below example is capable of stretching and squashing but its volume remains constant. The water inside it neither increases nor reduces while the stretch and squash happen.



Exercise:

For practicing stretch and squash it's better to try animating a bouncing ball and apply the principle to understand how stretch and squash work.

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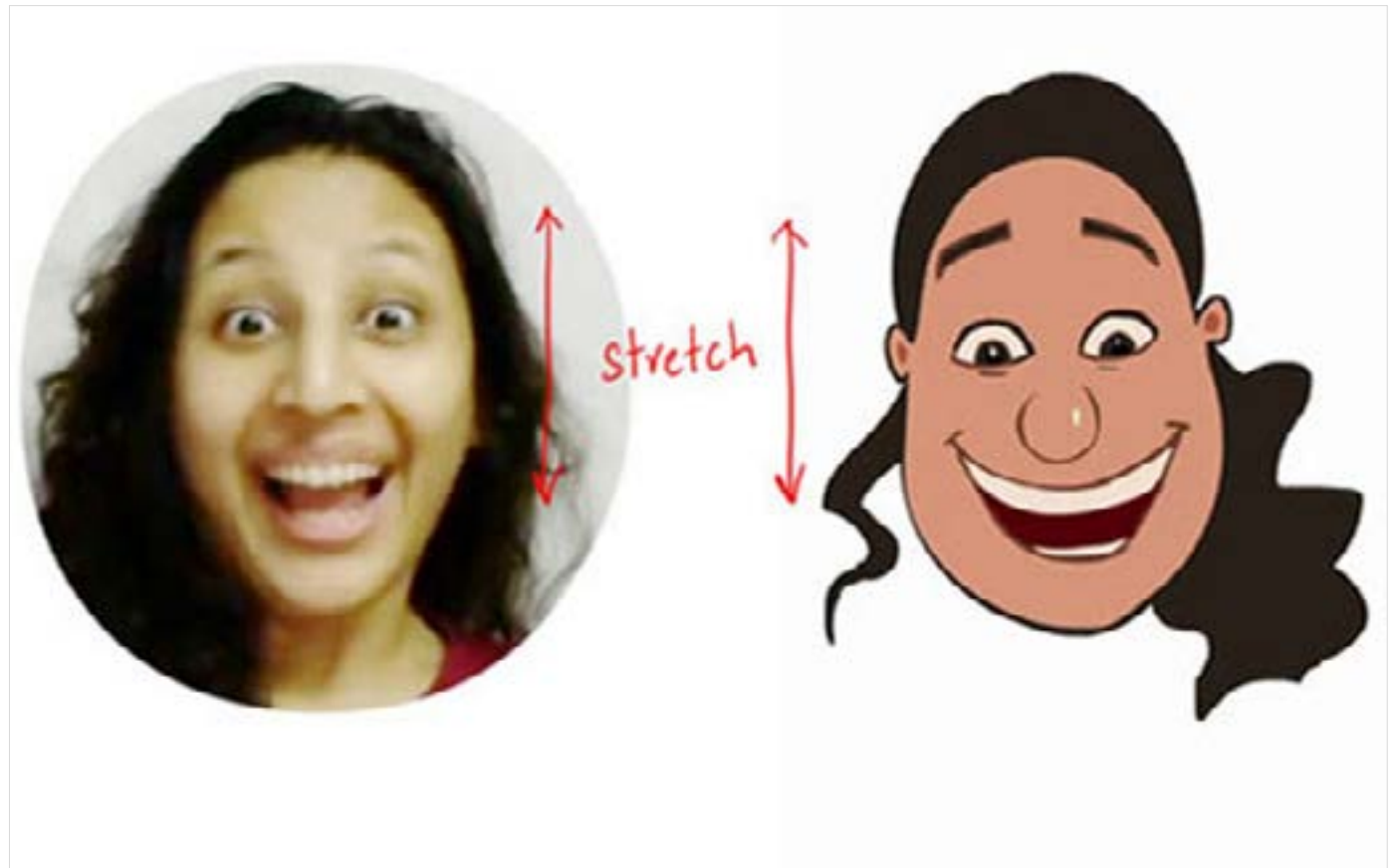
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Facial Expression Example

This principle is prominently visible in Facial character animation. Our face is made up of so many complex muscles. We stretch and squash our facial muscles to depict certain emotions. So while animating, one can use this study to bring out or exaggerate an expression by using this principle effectively. When a muscle is contracted it will squash and when extended, it stretches.

Even while watching the movies one can notice these stretch and squash which we generally miss out. One should try to pause an animation movie like say Tom and Jerry or any Disney movie for example and look for moments where they have used stretch and squash.



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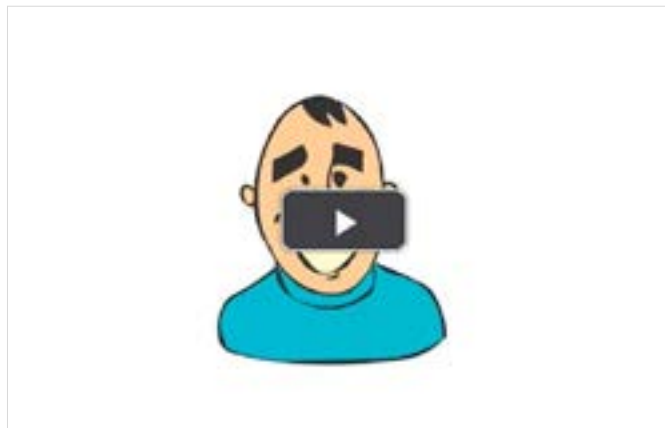
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Source:

<https://dsource.in/course/principles-animation/anticipation>

Anticipation

There are majorly three things in animation:

1. Anticipation (preparation for the action)
2. Action
3. Reaction (termination of the action)

“If you can learn to do these things well, you can animate well.”

The great animator Bill Tytla, who clearly defines to understand the importance of anticipation in animation, gives this great suggestion.

Anticipation, which is the first part of making an action while animating, communicates what is going to happen. We need to emphasize on **using big anticipation**. The audience sees what is going to happen and so they anticipate with us.

Thus, anticipation can be called as the **preparation for an action**.

Anticipation can also create the perception of weight or mass.

Some points to be noted for anticipation are:

- The anticipation is always in the opposite direction to where the main action is going to go.
- Any action is strengthened by being preceded by its opposite.
- Usually the anticipation is slower and less violent than the main action, i.e. **Slow anticipation = fast action**
- Any action can be enhanced if there is anticipation before the action.

Examples:

Physical Preparation for the Action:

Here the character with the axe anticipates to cut the tree.

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Preparing the Viewer for the Action to Come:

Here the character anticipates a bit to sneeze, thus preparing the audience for the sneeze to come.



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Internal Struggle:

Here the character is tense and the anticipation helps to enhance the tension, thus bringing clarity to the action.



Kindly refer to the video for details:



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Staging

Staging is fundamentally the most important principle to be kept in mind while Animating and planning a scene.

Always stage an action so that the audience understands it. If you are staging a character or a personality make sure it's recognizable. Also, good staging helps in reading the expressions of the character clearly and overall helps in pushing the mood of the scene, thus engaging the viewer.

Below are the points one must keep in mind.

1. 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 Storyline. A better silhouette and a strong pose read better.



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2. The effective use of long, medium, or close up shots, as well as camera angles also help in conveying the story. Since in a film there is a limited amount of time, thus each sequence, scene and frame of film must relate to the overall story.



3. Do not confuse the audience with too many actions at once. Use one action clearly and get the idea across, unless you are animating a scene that is to depict clutter and confusion. Take control of what the audience look first.

Like in the example below (refer to video for details)

First you see the main character watching TV, second the rat appears and then the character reacts and then the Cat pops out.

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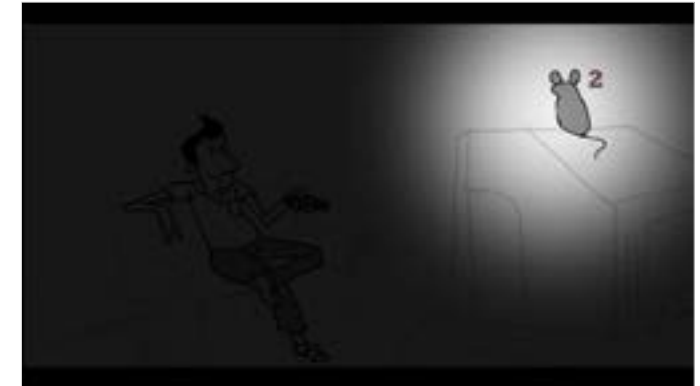
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4. Staging directs the audience's attention to the story or idea being told. Care must also be taken in background design so it isn't obscuring the animation or competing with it due to excess detail behind the animation. Background and animation should work together as a pictorial unit in a scene.



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5. While animating a scene, planning out with rough thumbnails always helps. Creating Thumbnail drawings for your scene in advance acts as a blueprint and brings clarity to the idea being conveyed. Also, it helps in detailing out the storyboard for further planning. It's a good way to resolve initial timing and composition for the scenes.

For further information refer to the video.



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Straight Ahead Animation



Straight Ahead
Animation

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Pose to Pose Animation



Pose to Pose Animation

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Follow Through and Overlapping Action

Another important principle to keep in mind while animating is Follow through and overlapping action.

Follow Through

It is the conclusion part of an action. When the main body of the character stops all other parts continue to catch up to the main mass of the character, such as arms, long hair, clothing, or a cape, floppy ears or a long tail. Always taking a bit more time to settle down and stop Remember nothing stops all at once.

An example is in throwing a ball - the hand continues to move after the ball is released.



Weight and Drag

Extensions or loose parts of a character or object will drag behind the leading part of the object. Then as the object comes to a stop, the looser parts continue to move taking longer to settle down and stop.

Like the cape in the below example:



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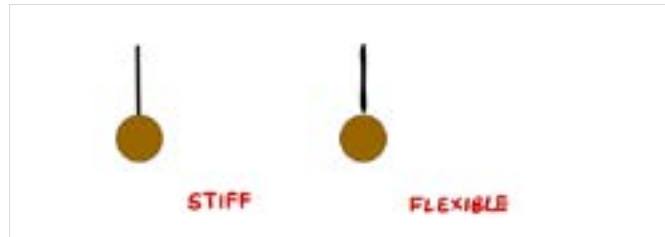
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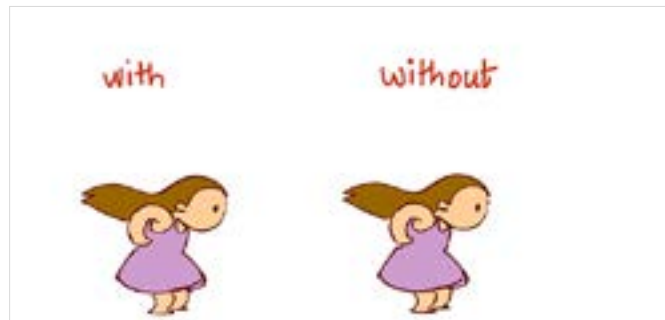
Weight of the appendages dictates the speed with which they follow the lead, heavier objects drag farther behind. Similar to the principle of squash and stretch the amount of drag you give to your subject, also defines the mass of that subject.

The First example appears to be like a stiff extension and the 2nd e.g. appears like a tail or a feather.



Overlapping Action

Slight variations in the timing and speed of loose parts make objects seem more natural. This overlapping action makes the objects and movement more interesting.



Heavier parts lag farther and stop slower. Like example below, where the leaf will lag behind the carrot and then move quickly to indicate the lighter mass.



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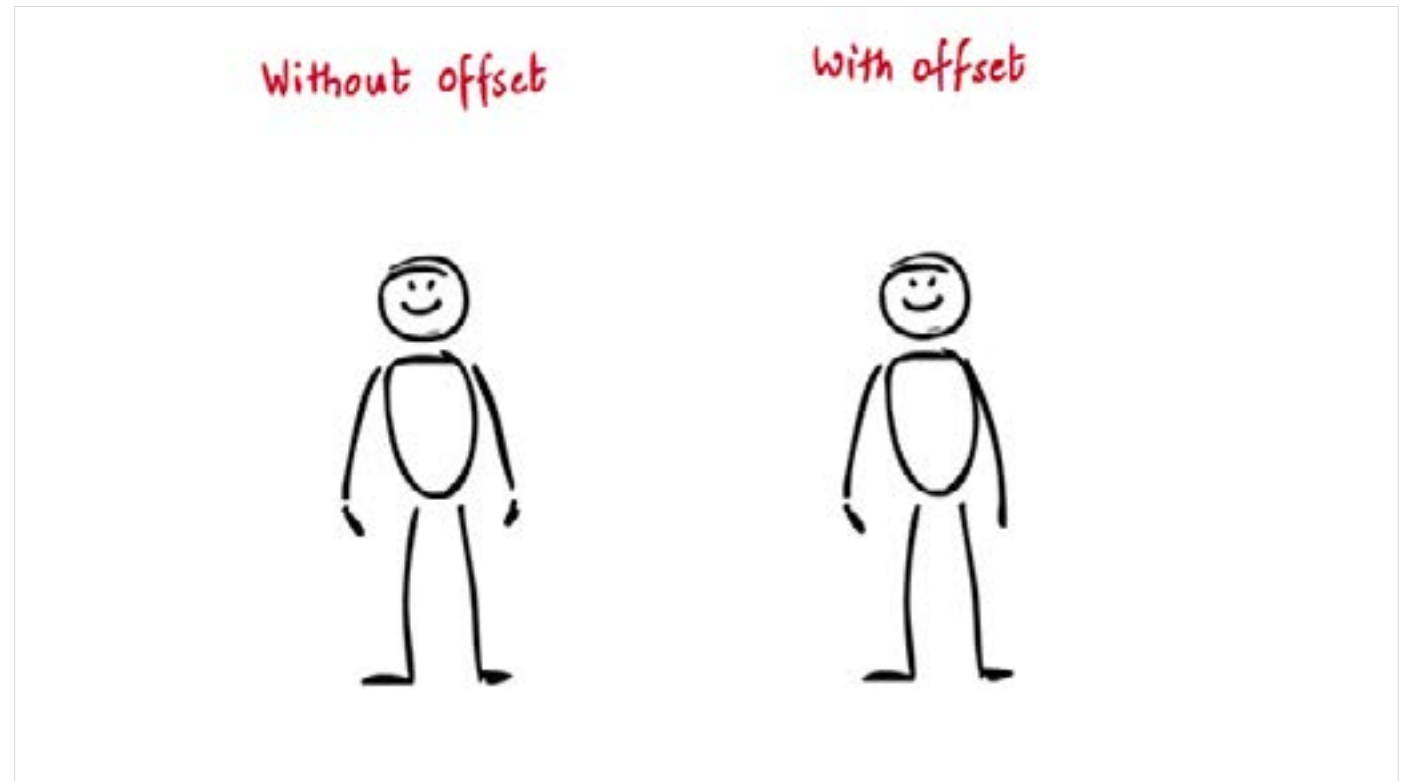
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Using overlapping action to break up an action makes it look much believable and fluid. It is done by offsetting the movements of the arms and legs as shown in the example.



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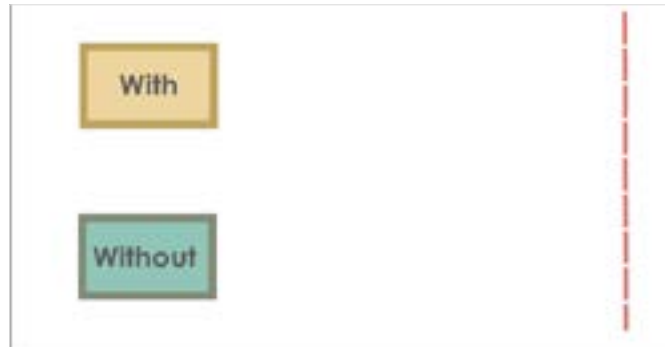
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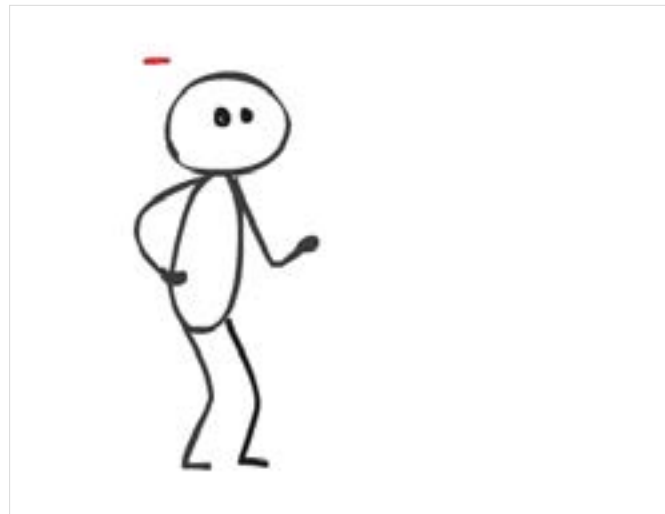
Slow In Slow Out

This Animation principle refers to how all movements begin slowly, built momentum and then finish slowly. Basically easing in and easing out of the action.

You can achieve believable life like movements using the principle of slow in slow out. Referring to the example below: Two boxes are moving from one point to another. The first (yellow) box eases into the movement and eases out as it stops. But the second (green) box has no slow in & slow out thus making it more drab and linear motion.



As action starts, we have more drawings near the starting pose, one or two in the middle, and more drawings near the next pose. Slow-ins and slow-outs soften the action, making it more life-like.



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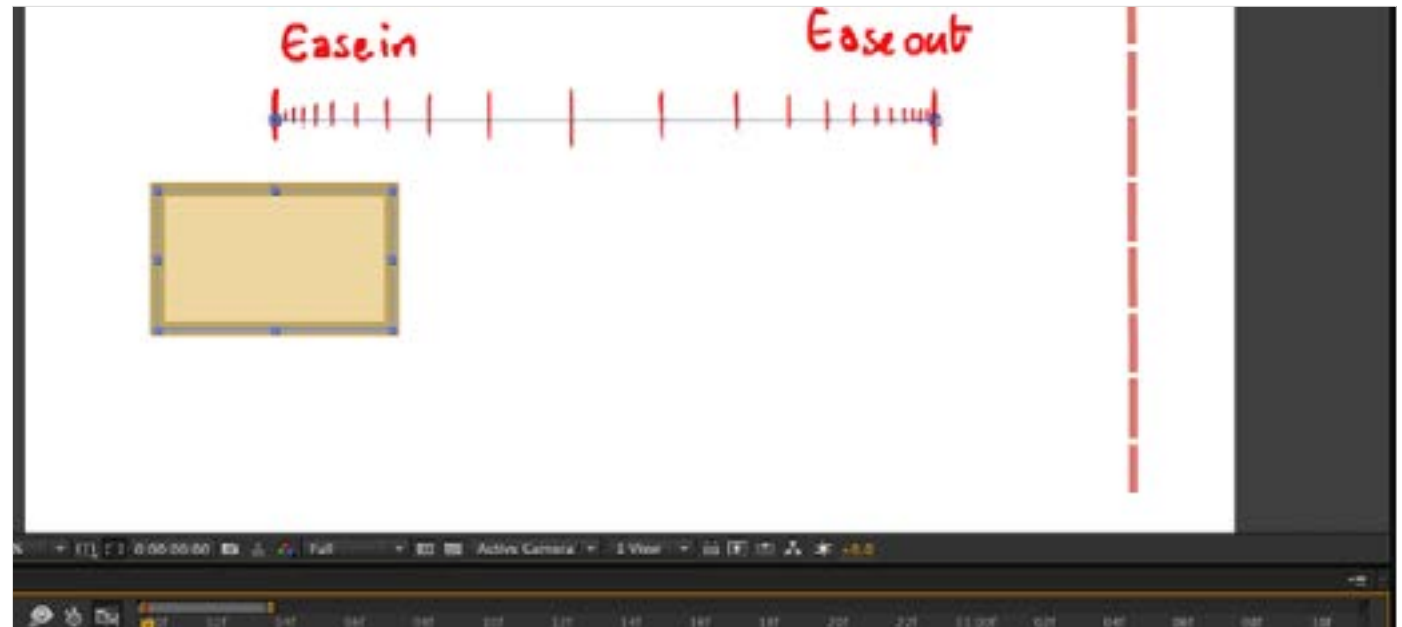
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<https://dsource.in/course/principles-animation/slow-slow-out>

You can apply this principle by adding more in-betweens towards your extreme poses. Like in the example below where the character is throwing the ball. There are more in-betweens at the beginning of the action and at the end of the action. This adds more life to the animation.



Also, these days to achieve slow in and slow out is a matter of changing the motion curves using Digital tools like Adobe Flash, After Effects or any 3D tool.



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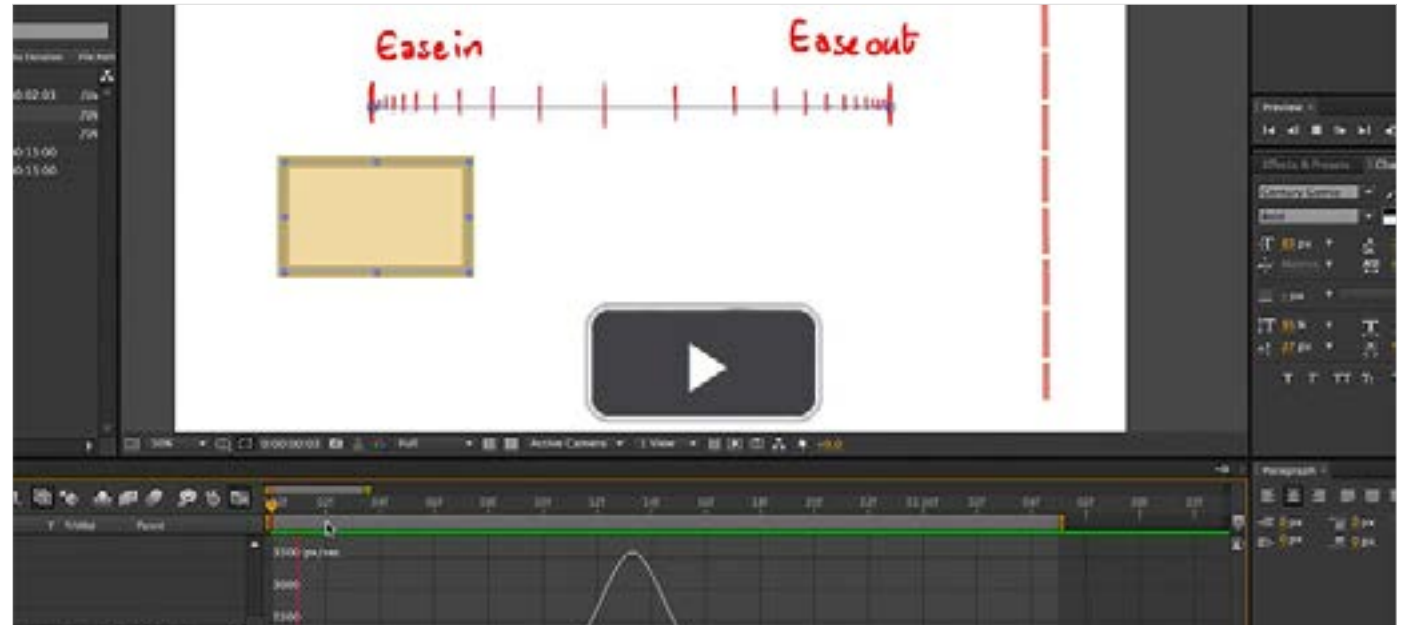
Source:

<https://dsource.in/course/principles-animation/slow-slow-out>

You can apply this principle in a limited animation scenario where even with just 2 keys and one in-between and adding few frames of slow in and slow out at the extremes can make the action look smoother.



For further details refer to the video.



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<https://dsource.in/course/principles-animation/secondary-action>

Secondary Action

A secondary action is any action that results from the primary action. Adding this principle to the main action gives the scene more life by supporting and enhancing the main action.

For example a person walking is the primary action.



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Now by adding secondary action like him holding a phone and bobbing his head adds more interest to this plain simple walk.

Or by adding his muffler waving can enhance the mood of the scene, making it look windier and tell the emotional state of the character.



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An Important thing to know about secondary actions is that they emphasize, rather than take attention away from, the main action. Like the guy in the example below is typing hard on the keyboard, by adding a subtle gesture of him wiping his forehead adds to the tension and conveys the idea of urgency.



Like anticipation, secondary actions can be used to help to strengthen the idea or feeling you are trying to portray. Like in the example below. The Character is waiting for his phone to ring. By adding subtle foot taps to the primary action of wait, enhances the mood of the idea being told.



Kindly go through the video for more information:



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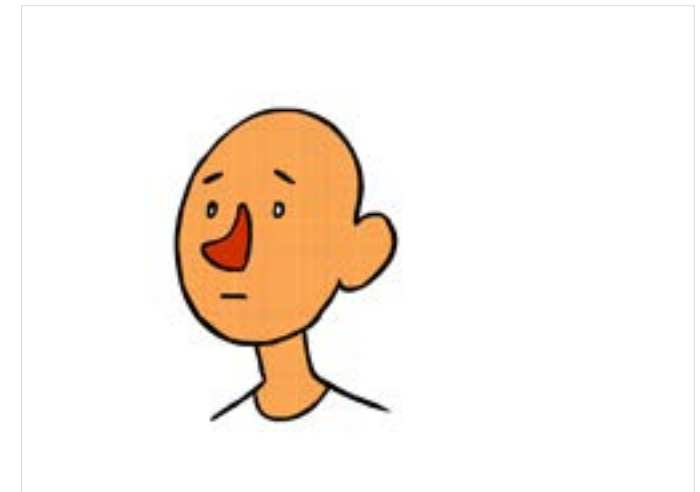
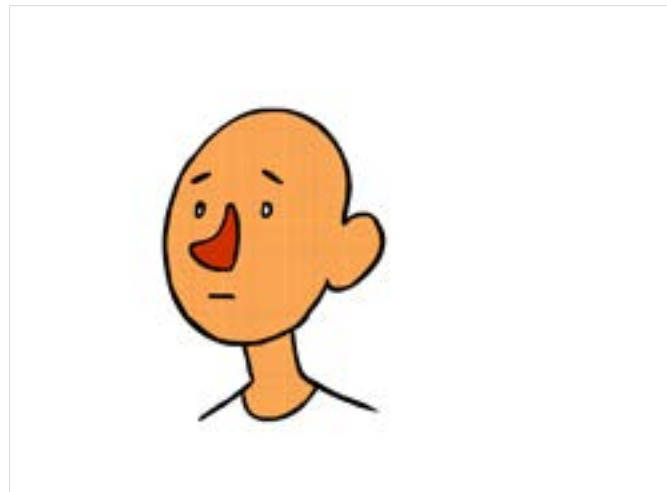
Timing

"Timing" refers to the number of frames or drawings in a particular action. So it also determines the speed of the action.

When you increase the number of drawings between two extreme drawings, the action will be slow and run for a longer time; and when the number of drawings in between the extremes is fewer, the action will be faster and would take less time.

This way, timing plays a very crucial role in establishing a character's nature, personality, mood and emotion.

For instance, the following character's head turn can be made to express anything by increasing or decreasing the number of inbetweens, i.e. by changing the timing.



With fewer inbetweens (3 drawings in this case), he seems to be appalled by something, and with more inbetweens (7 here), he seems to be casually turning around; and so on and so forth.

In any given action, it's not just the number of frames in between the extreme poses that conveys the mood or nature of the action, but also how close or farther apart the frames are drawn, which in other words is called "Spacing".

Spacing is generally referred to as how much the consecutive frames overlap.

An easy example to understand is of these two balls, which have the same timing moving from one point to another, yet their actions are drastically different.

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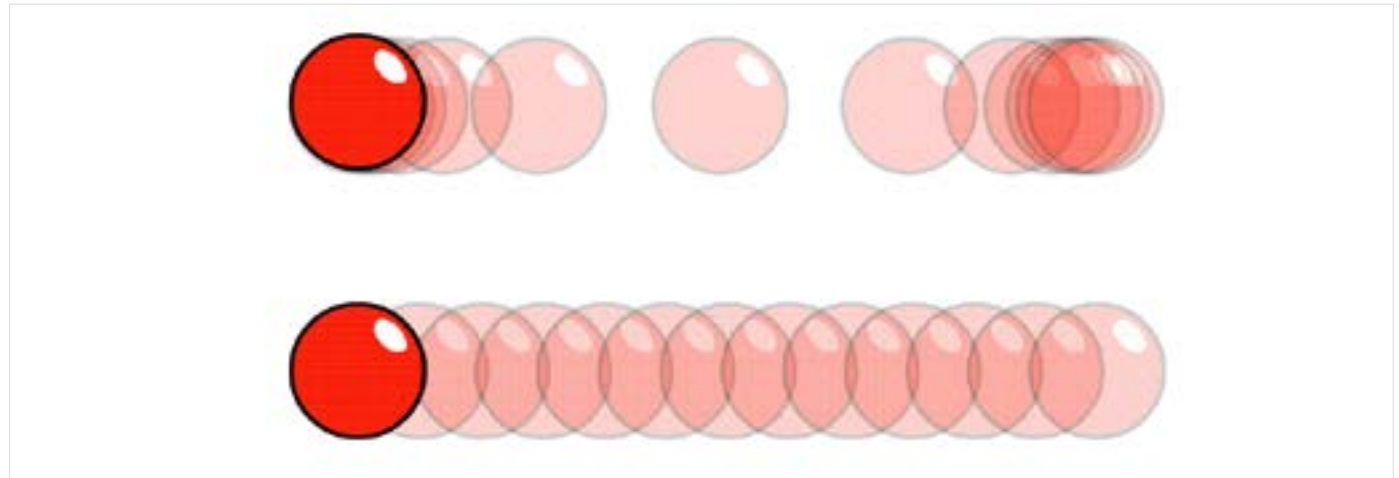
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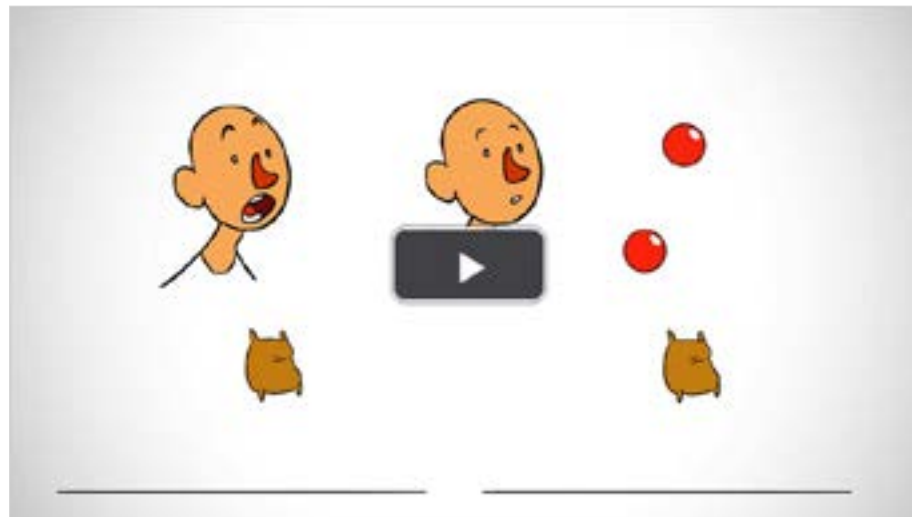
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It is because the spacing in both of them is different. The below one has evenly spaced drawings, and has a uniform motion. At the same time, the one on the top, with same number of drawings, but with some adjusted spacing has a more snappy motion.

So, with meticulous timing and spacing, you can make your animations more expressive, engaging and entertaining; and communicate with your audience better.

For more illustrated examples, refer to the video.



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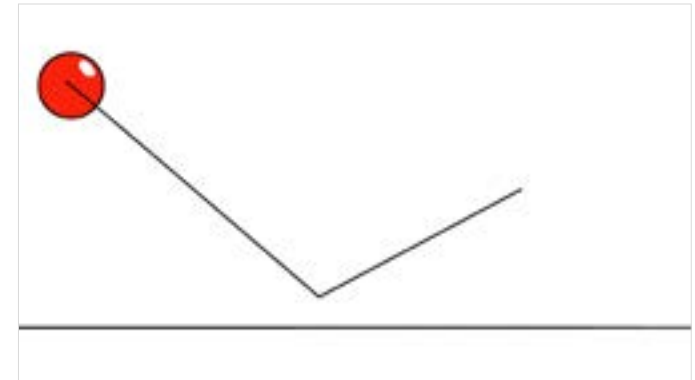
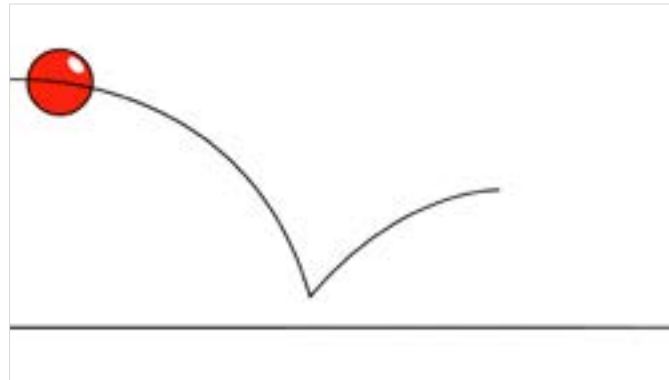
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Arcs

The movements and actions that we see in nature and living beings in our day to day lives are very rarely mechanical in and out or up and down motions. Generally, most living creatures follow an implied curved path, also known as an “arc”.

Meaning to say that all the actions that we generally see in our day to day lives follow arcs.

The most basic example would be of a bouncing ball. See how it follows a curved trajectory and not a mechanical straight line.



Arcs make actions look more believable and fluid, making them more pleasing and appealing to watch.

In complex actions, there can be multiple arcs being traced. For example, this dancing monster has its hands, feet and body, all moving about their own individual arcs. Hence, five arcs are being followed in one action of it dancing.



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If we go in more detail, we'll find that the monster's horns, elbows, knees, eyes, mouth, teeth, et al. follow their own arcs as well.

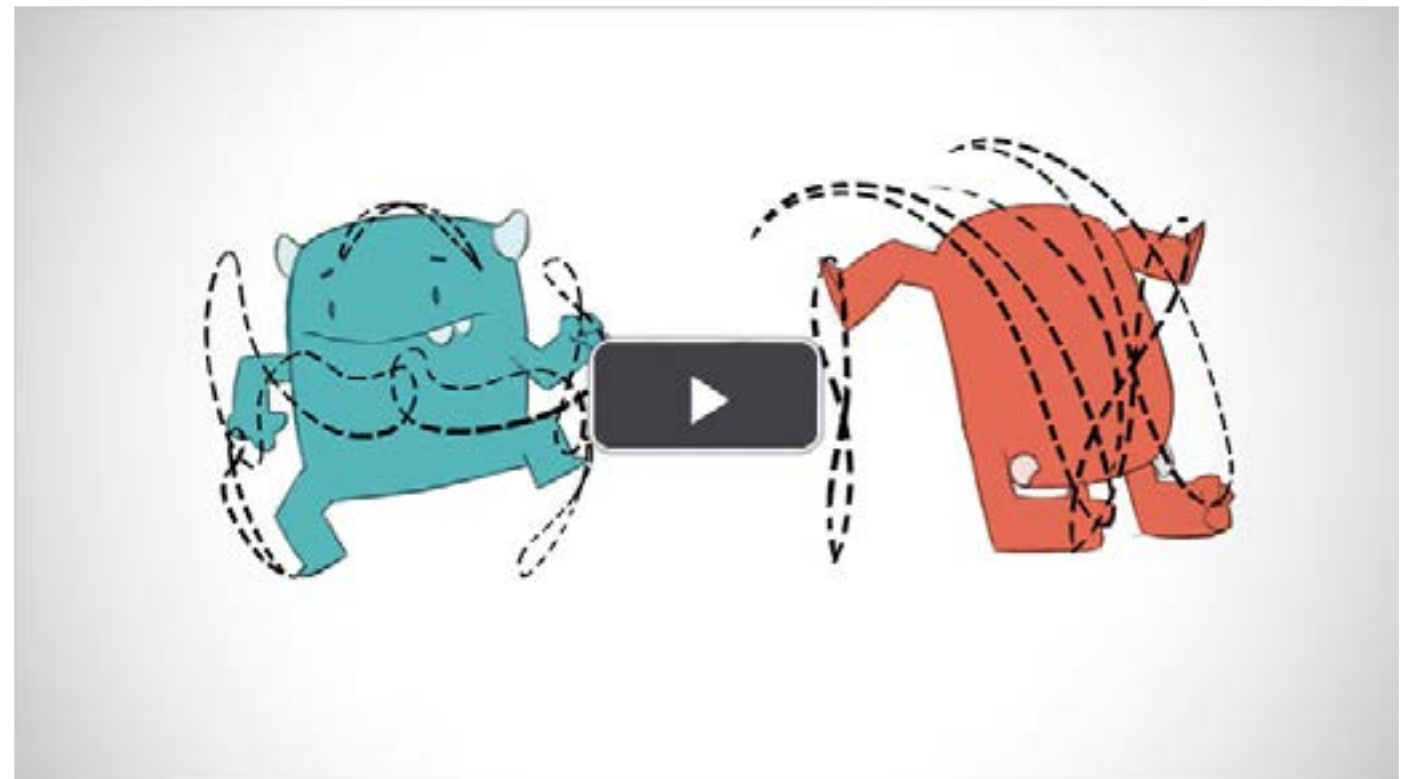
So how do we keep track of all these arcs while animating?

The answer is, by flipping. Constantly flipping or rolling your drawings while animating gives you a fairly great idea of the natural arc of the movement.

In some cases when the number of arcs are just a handful and fairly simple, it is better to draw them out on a layer below and animate on top of that.

Arcs are everywhere. It's a great exercise to observe the movements in your day to day life and see how they trace their paths. So, as the saying goes, "Watch the arcs!"

For more illustrated examples, watch the video.



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Appeal

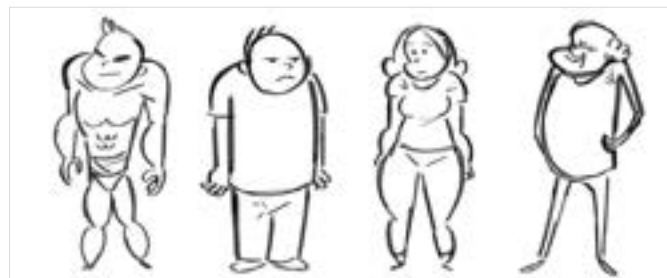
Appeal is one of the animation principles, which makes the character or design stand out. Viewer feels realism and it generates further interest when an appeal is added to the design. Character should be capable of creating a pull when presented. They should have charisma.



Appeal is not only used for the lead characters. But also villain, sidekick and every other character.



Instead of using the same variety of shapes to all the characters, You can play with them in shape variation and use it according to their personalities. Every good character have clear shape.



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Playing with proportion and Pushing it

Exaggerate the things which looks interesting in design. Push the shape further.



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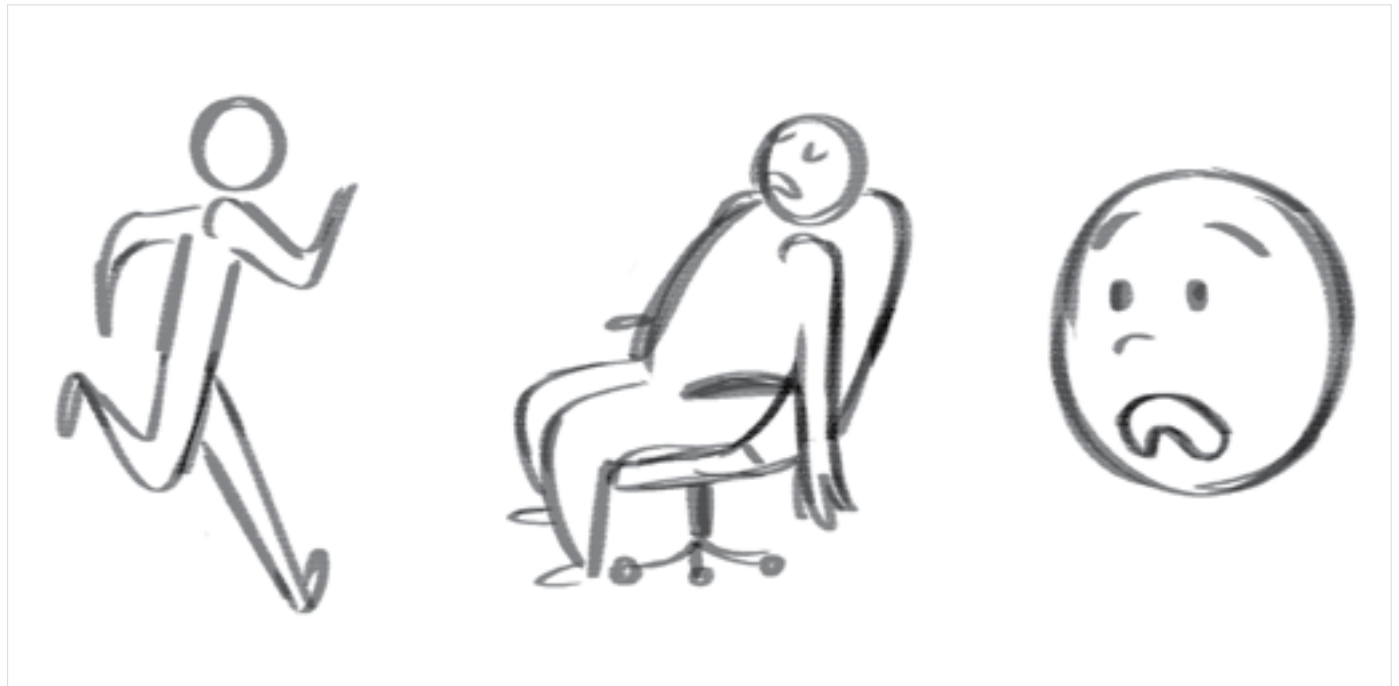
<https://dsource.in/course/principles-animation/exaggeration>

Exaggeration

Exaggeration is the animation principle, introduced by the great animation masters Frank Thomas and Ollie Johnston.



This principle is used to push the movement further and add more appeal to an action, pose or expression.



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*How does it work?

A person is afraid and is looking backwards So while drawing the pose think about what is he thinking? and What is he feeling and try to push pose as compared to the normal.



You can keep adding the exaggeration until you get satisfied. A person is watching TV.



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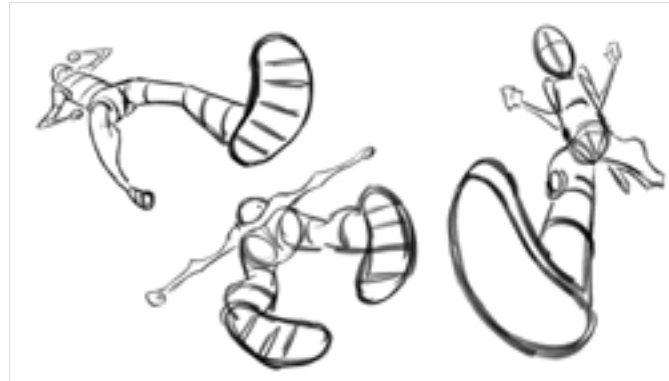
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Solid Drawing

Solid drawing is the animation principle which makes the drawing look Three dimensional and believable with Volume, Weight and Balance.

This requires the knowledge of drawing a subject three dimensionally.



With Solid drawing you will be able to draw figures from any side, which will help in animating your drawing.



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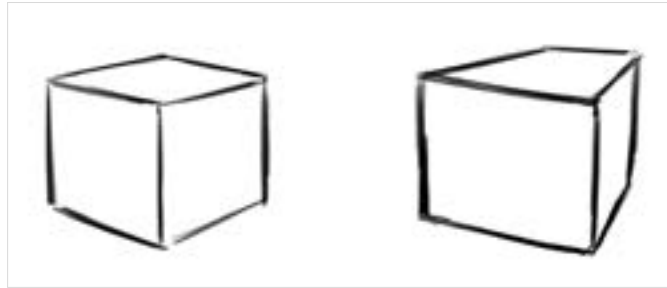
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When drawing the cube, Avoid making parallel lines. The lines should be bend towards the vanishing point otherwise it becomes an isometric flat cube.



Here is the rough pass of designing the character with the solid shapes.



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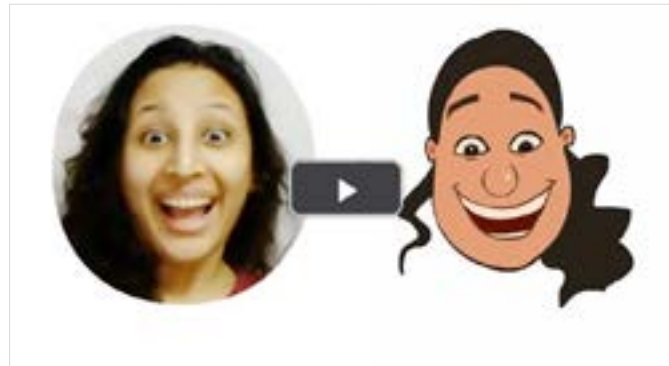
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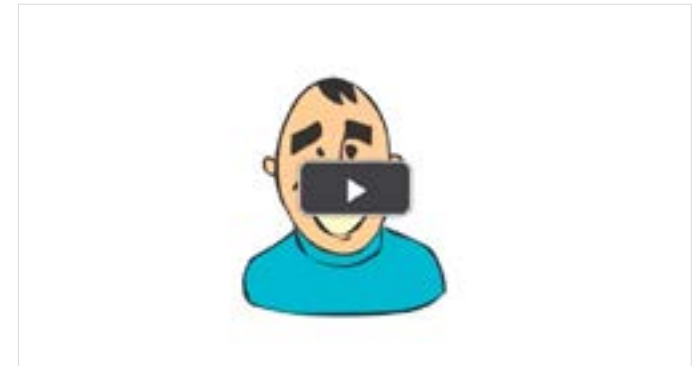
Bouncing-Ball



Jump-Action



Facial-Expression1



Facial-Expression2

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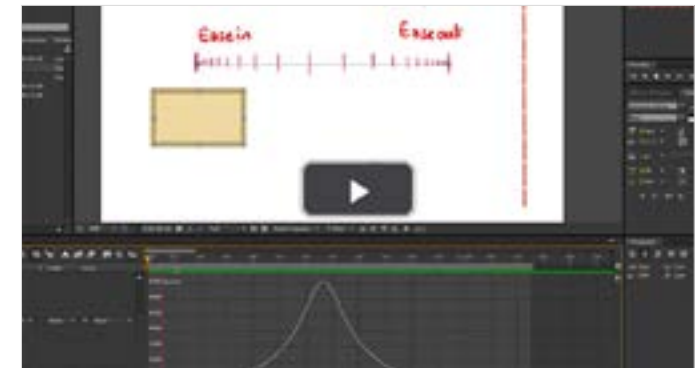
Anticipation



Staging



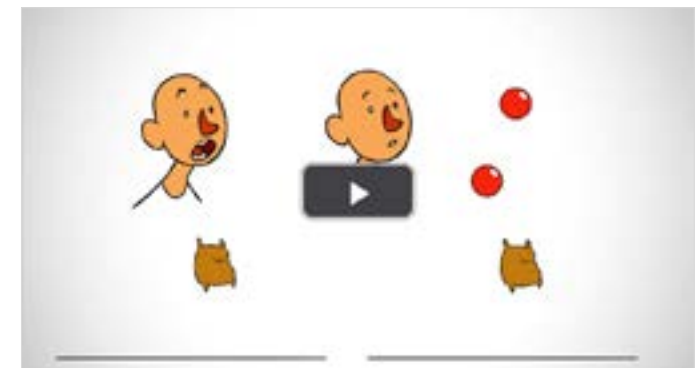
Follow Through and Overlapping Action



Slow In Slow Out



Secondary Action



Timing

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Arcs



Appeal



Exaggeration



Solid Drawing

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