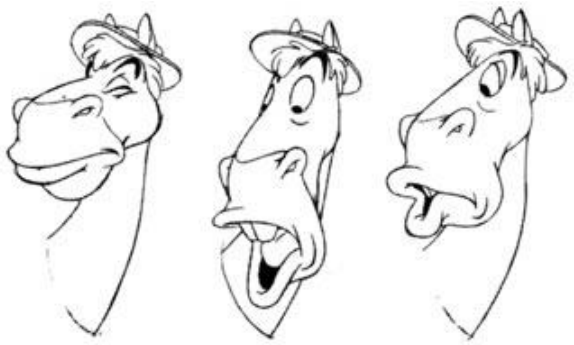
ROCKET SKY PRINCIPLES OF ANIMATION

INTRO TO SQUASH AND STRETCH



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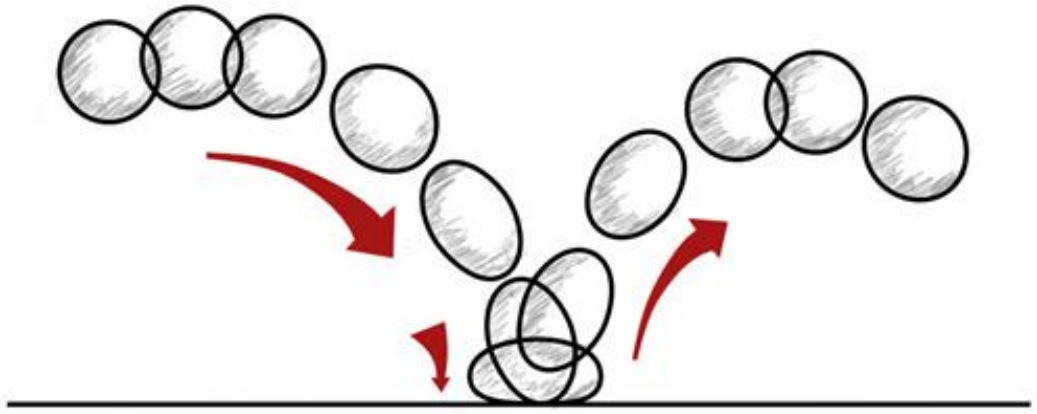
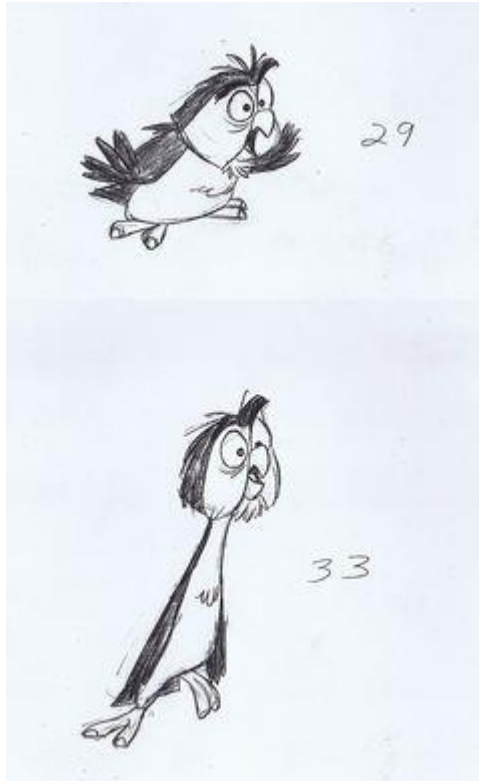
The first principle of animation is "**Squash and Stretch**", the purpose of which is to give a sense of weight and flexibility to drawn objects. It can be applied to simple objects, like a bouncing ball, or more complex constructions, like the musculature of a human face. Taken to an extreme point, a figure stretched or squashed to an exaggerated degree can have a comical effect. In realistic animation, however, the most important aspect of this principle is the fact that an object's volume does not change when squashed or stretched. If the length of a ball is stretched vertically, its width (in three dimensions, also its depth) needs to contract correspondingly horizontally.



What is Squash and Stretch?

This is single-handedly considered the most important principle of physical animation. Well executed, it is a vital component in making otherwise stiff and dull characters look organic and lively on-screen.

Using it simply means drawing or posing figures in deformed -- squashed or stretched -- poses. It can be applied to objects and creatures, as a whole or restricted to more flexible parts when under the action of gravity or some other pull or push.



Here are a few examples of **Squash and Stretch** :

- A bouncing rubber ball squashes when it hits the ground, then stretches back upon rebounding.
- Facial expressions:
- squash: in a big smile not only the mouth and cheeks move, we have eyes squinting and more -- the whole face can be involved;
- stretch: yell! With the jawbone open wide, the face gets longer, looking stretched.
- Gravity pushes all things down. Cloth, fat tissue and aged stretched skin show this effect clearly.
- A spring can be compressed; once freed, the released potential energy makes it stretch past its equilibrium point, building some potential energy again. This makes it compress again... and so on, until all the added energy is dissipated and it comes to a rest.

Rubber Hoses and Circles
In its earlier form, squash and stretch was already extensively used during the 1920's, in cartoon series featuring Felix the Cat or Betty Boop, just to name a few.

Why use Squash and Stretch?

The reasoning behind this principle is obvious: many real materials are pliable, including but not limited to soft organic matter and anything rubbery or jelly-like. This must be accounted for in more realistic drawings, paintings, sculptures and, as animators soon discovered, it's a vital effect when things start moving, because movement emphasizes any rigidity in a silhouette.

So they started squashing and stretching in their sequences of poses. The effect was heavily explored in sight gags (those short visual jokes sometimes involving pies), with character's arms, legs, necks or whole bodies extending almost to no end when pulled.
That could be funny, but it was also unrealistic in a primitive, disruptive way. One that wouldn't work in the new kind of films they were planning to create, with engaging stories, appealing characters and well developed scenes.

They needed to draw squashed and stretched shapes to represent flesh and other flexible materials and so the principle was born out of this fundamental animation exploration.

Volume Preservation

The key detail that raised Squash and Stretch to a principle is in fact quite trivial to understand:

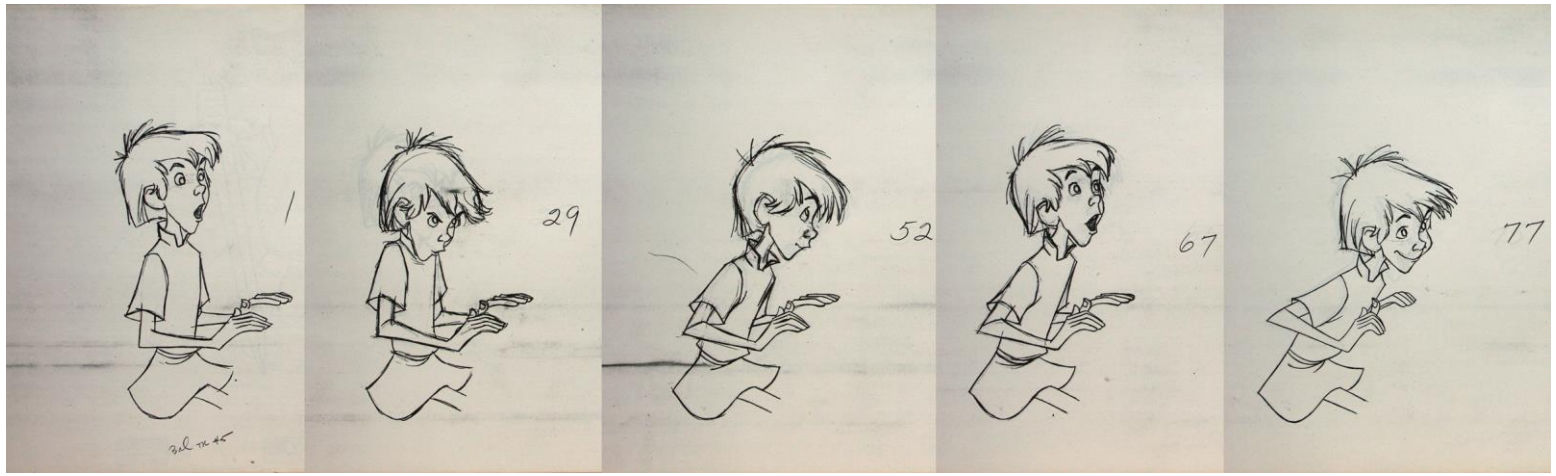
- stretching does not mean enlarging
- squashing does not mean shrinking

In short, **the volume must be preserved!**

Not preserving the volume is one of the most noticeable mistakes an animator can make.

Pulling a cartoony arm to twice its length is fine -- hey, cartoon's natural laws allow that! The problem is doing so without thinning the arm to compensate. If something becomes extended along one of its axes, it must be compressed along the other two. Example: a rubber ball elongated in Z should be squashed in its X-Y plane accordingly, or it will seem that the ball increased in size.

Everyone will perceive it. For this very reason it's also a simple problem to fix. It's not necessary to calculate the volume of the new shape precisely -- eyes and good sense are enough, in general.
Squash and Stretch proved to work so well on the screen that animators felt like getting to the heart of it. They would use the effect whenever possible and kept on experimenting, overdoing it to amusing results.
But apart from this exaggeration -- in itself another of the principles -- there's a real feature. Studying images and videos of athletes, for instance, they realized that Squash and Stretch in fact was more pronounced in the real world then they imagined, which justifies its wilder use in animations.

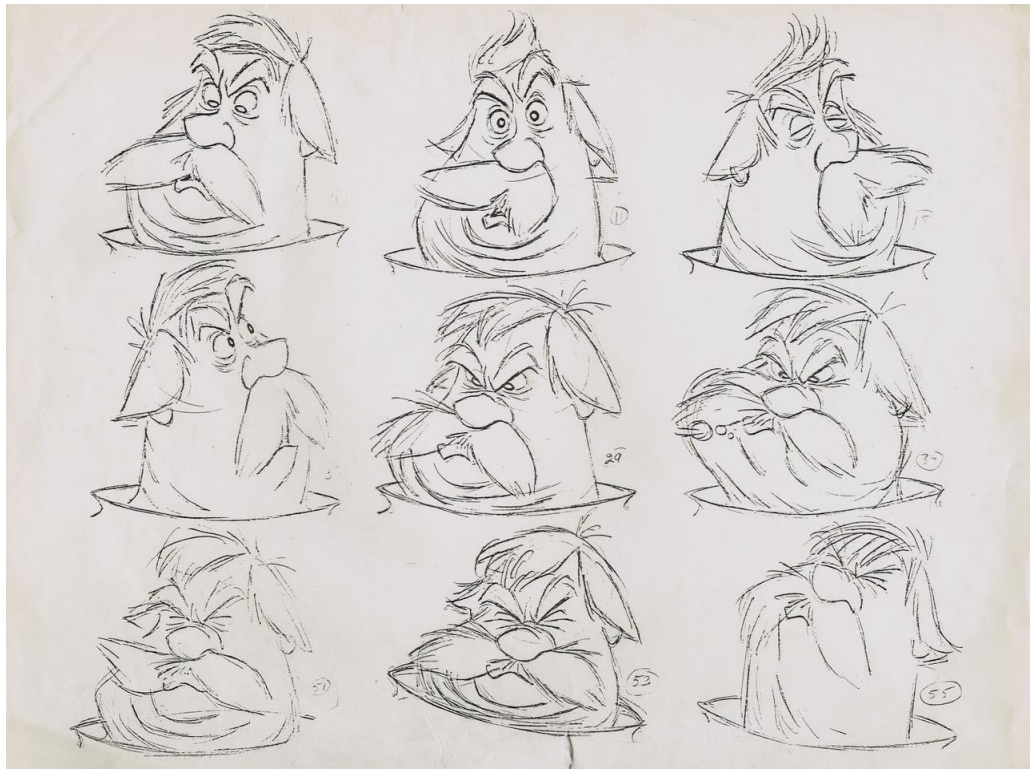


Facial Expressions

One of the most important applications of Squash and Stretch is in facial animation, both realistic and cartoony.

Artists responsible for creating blend shapes for expressions (opening the mouth, smiling, frowning, squinting, etc.) and phonemes or visimes (*) for lip synchronization have to pay close attention to how the skin stretches and bulges and where creases appear in each expression.

Cartoons, as we know, can have very pronounced squashing and stretching in exaggerated expressions. While realistic faces don't go anywhere that far, opening a mouth causes a slight head stretching -- we just need to be careful to do it properly. The mirror and pictures are always good references.

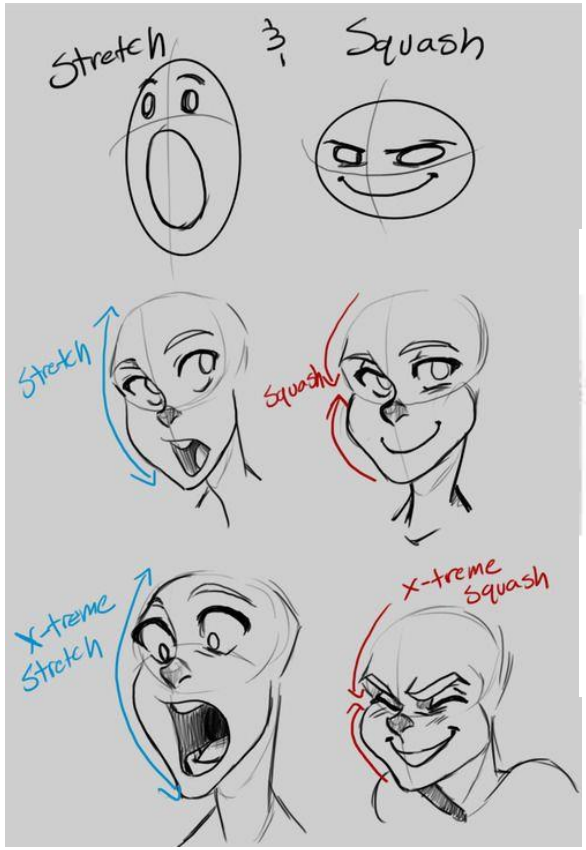


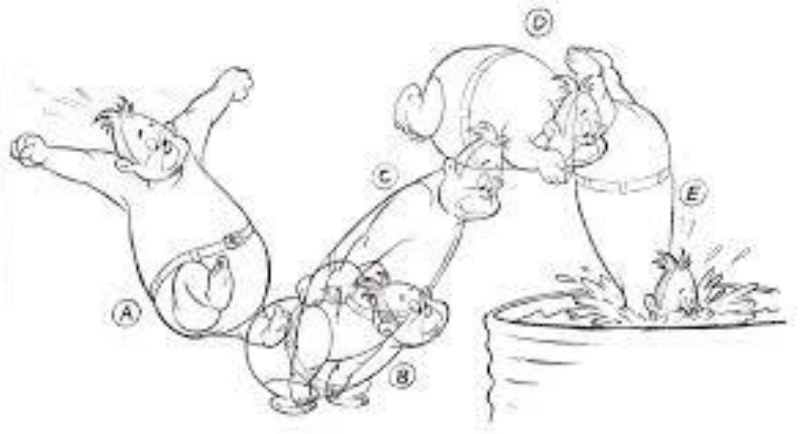
Extremes & Inbetweens

A great way to apply squash and stretch that works well in cartoons when only a quick effect is wanted, is to do it right before an **extreme; a**n **extreme in animation is a main pose, better crafted and meant to be seen for a longer time** . This way the deformation can barely be seen, but it still does its job, helping make the action look crispy and natural.

As an illustration, consider a frightened character. We can stretch his head shortly while he screams (*), but only for a frame or two right before entering the main pose for that action. The deformation is barely noticeable, while the extreme, undeformed and with slow in and slow out, is clearly shown to the viewers. Good exercise: animate this without the stretch, then add it and compare both versions.

Where does the justification for this stretching comes from? Hint: look at yourself screaming.


Stretch
Squash
Stretch
Squash
X-treme Stretch
X-treme Squash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