

The GDC logo is in white, bold, sans-serif font. The background of the slide is a dark teal color with several 3D wireframe geometric shapes in orange, red, and white. A large, complex polyhedron is on the right side, and smaller cubes and other shapes are scattered around it.

GDC

Zip! Thwack! Ping! Animation Principles of VFX

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Hi everyone. I'm Mike Lyndon. Welcome to my talk Zip! Thwack! Ping! Animation Principles of VFX.

So why do this talk? I think the principles of animation are a key ingredient to making a good effect. But there's not a ton of info available on how to apply those principles to realtime vfx. That's not to say that there aren't some great resources available but I wanted to make a more deliberate connection between the 12 principles of animation that Disney's 9 old men formulated over the years and realtime vfx. Hopefully this gives you one more tool in your kit to make an awesome effect.



Ender's Game



Gears of War 4



Happy Feet 2



So here's my back story. I think like a lot of vfx artists my journey has been a winding path. I started out as a generalist working on commercials back in South Africa. At the time, like a lot of people I knew, I wanted to be a character animator at Pixar and study through animation mentor. So I started studying animation and the 12 principles. Along the way I needed characters to animate so I learned how to rig and script and discovered I really enjoyed the technical side of computer graphics. Which is when I discovered I could have my cake and eat it if I worked in vfx – I could create beautiful art AND scratch the itch in the technical part of my brain. I worked in the film industry for a while. Some of the projects I'm most proud of include Enders Game and Happy Feet 2. There are others but I'm too embarrassed to list them here. And then I finally got my break in games when I joined The Coalition and lead one of the most talented vfx teams I've had the pleasure of working with on Gears of War 4.



Complementary Material

- Artistic Principles of VFX
by Hadidjah Chamberlain, Jason Keyser
- The VFX of Diablo
by Julian Love
- VFX Style Guide of League Of Legends



Before we get started I thought it was worth mentioning some other talks or resources that would complement this talk. These all focus on the thinking behind the vfx rather than specific tools. I believe these are the kinds of reference you can keep coming back to as you improve as an artist or just want a quick refresher from year to year.

Last year Jason and Hadidja gave a great talk on the art principles of vfx. You can find it in the gdc vault which you should all have access to. If not, Jason has recently released a similar version of that talk on youtube. You can just google "artistic principles of vfx". It's the 1st or 2nd link that comes up. In their talk Hadidjah and Jason cover gameplay, shape, value, color and towards the end Jason touched on animation and that's where this talk fits in.

Also in the vault is the Diablo talk given by Julian Love. He does a great job of deconstructing an effect and how to implement it so that it achieves the goals of the game.

And rounding out this list is the League of Legends style guide. It's a handy document which expands on what the other 2 talks covered in a friendly infographic kind of way.



Animation of VFX

1. Principles of Animation
2. An Animation Framework
3. VFX Examples
 - Common Mistakes



In the next hour I'll start with a brief overview of the principles of animation. You may already be familiar with these so bear with me. I want to lay the foundation for what I'll be covering in the rest of the talk.

Then I'm going to cover my animation framework. This is a collection of ideas and techniques for getting the most out of your vfx. These ideas are not new and you may be doing them already in your own way. But I think this framework can help you strengthen your animation and understand what to look for in an effect.

Then I'll dive into some examples because what I want to show you is how we can use these traditional principles and techniques and apply them to everything from weapon effects to fluid simulations in your favourite 3D package.

Throughout the talk I'll also mention the common mistakes I see on forums and in showreels and how you can avoid them.



Animation of VFX

1. Principles of Animation
2. An Animation Framework
3. VFX Examples



So first up, I wanted to give a brief overview of the principles of animation since they're the underpinning to a lot of what we do when animating something.



Secondary
Action

Arcs

Follow
Through

Exaggeration

Staging

Slow In &
Out

Timing

Anticipation

Solid Poses

Squash
& Stretch

Layering of Principles



These are the 12 principles of animation that were developed over the years by the animators at Disney as the craft matured. I think trying to hold 12 ideas in your head at the same time is pretty difficult so let's make it a little easier and remove 2 of them. I'm not going to be talking about Pose 2 Pose vs Straight Ahead because I don't think the concept is as relevant to realtime vfx. And I'm not going to cover Appeal because I think there are other resources that have already covered that. Jason and Hadidjah's talk would be a good start.

That leaves us with 10 which is still going to be difficult to hold onto all at once. So instead I'm going to present these ideas roughly in the order of importance. I want to build a foundation, flesh that out and then refine my ideas. This is just my take on how I prioritize the principles. If you watch Jason's talk you'll see that he has a slightly different top 4. So feel free to mix and match but this lets me focus on no more than 4 principles as I layer on more and more ideas.

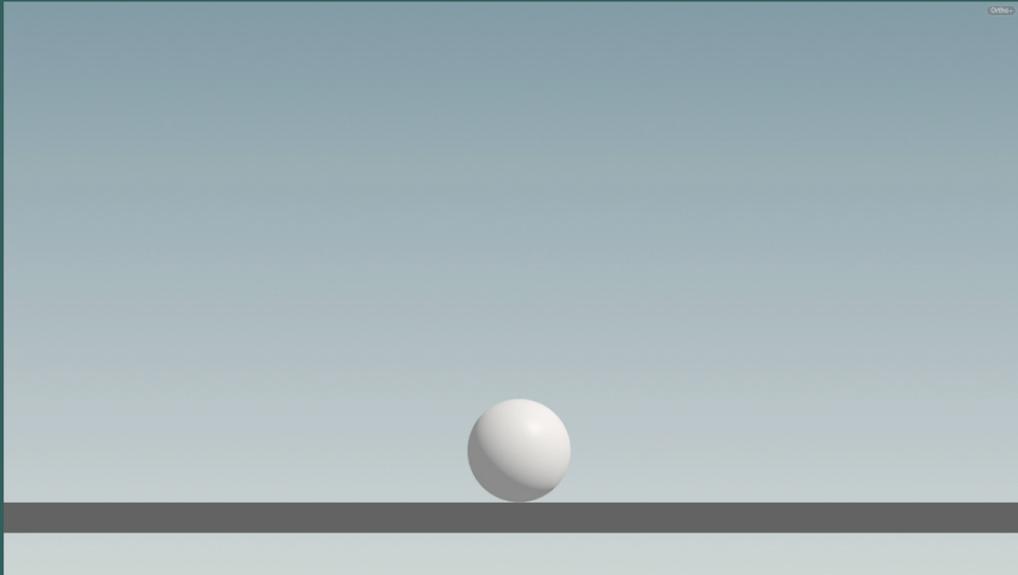
Let's have a quick tour of the principles I'll be talking about.



Principles of Animation – Squash & Stretch



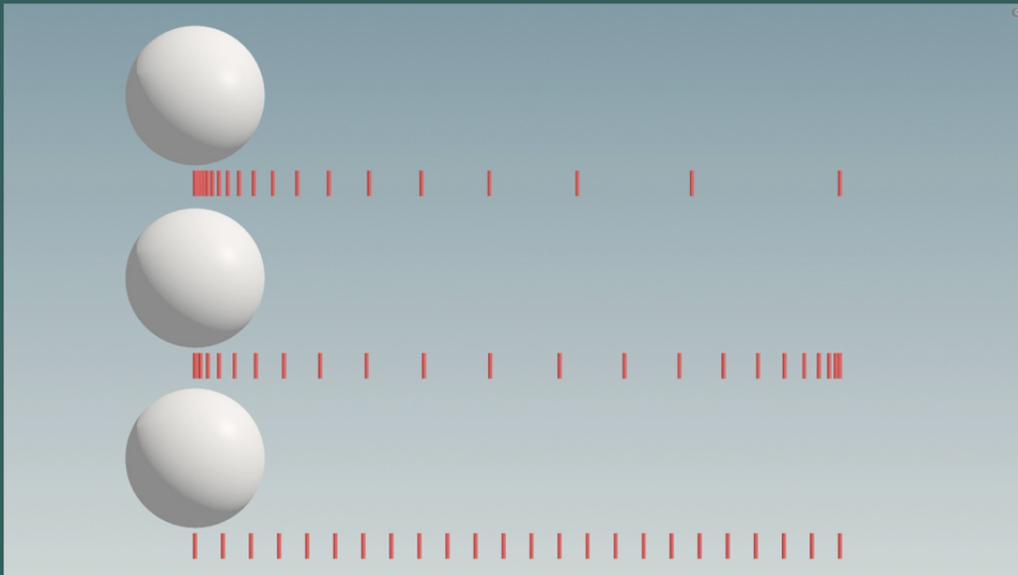
Squash & Stretch – This adds life to an animation. Helps make it less rigid. We create a contrast through the change of shape to give something a feeling of flexibility and life. When done right it makes the entire animation stronger. It can be seen in the build up and release of a pulse cannon or to exaggerate the movement of sparks flying through the air.



Principles of Animation – Anticipation



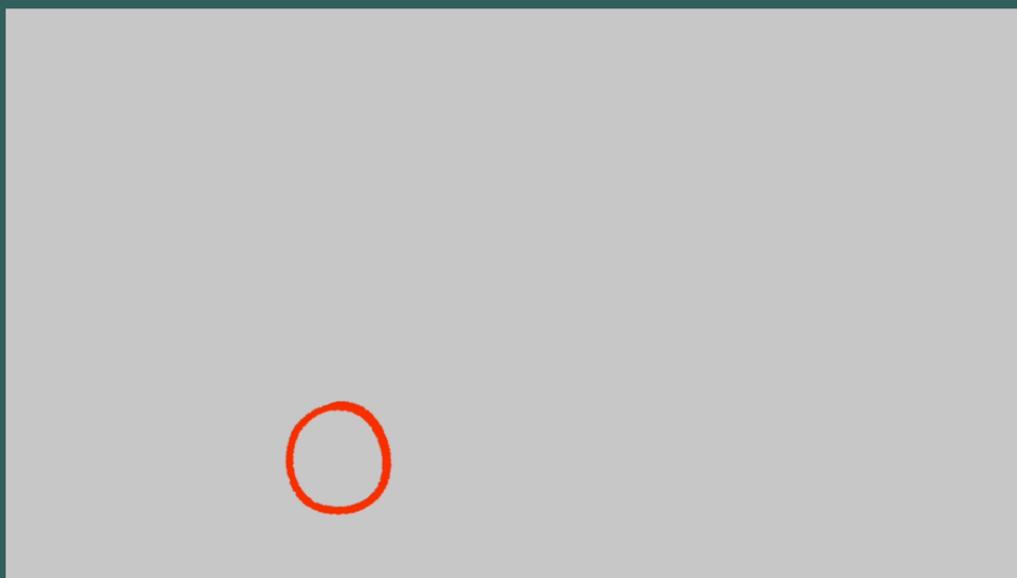
Anticipation – This principle is so important in animation and in games. We want to let the player know something about to happen. An attack in a fighting game, a bomb about to go off. An alt that's about to wipe out your entire team. Anticipation is the start of your story. Without it, it's like jumping halfway into a movie and not knowing what's going on.



Principles of Animation – Timing



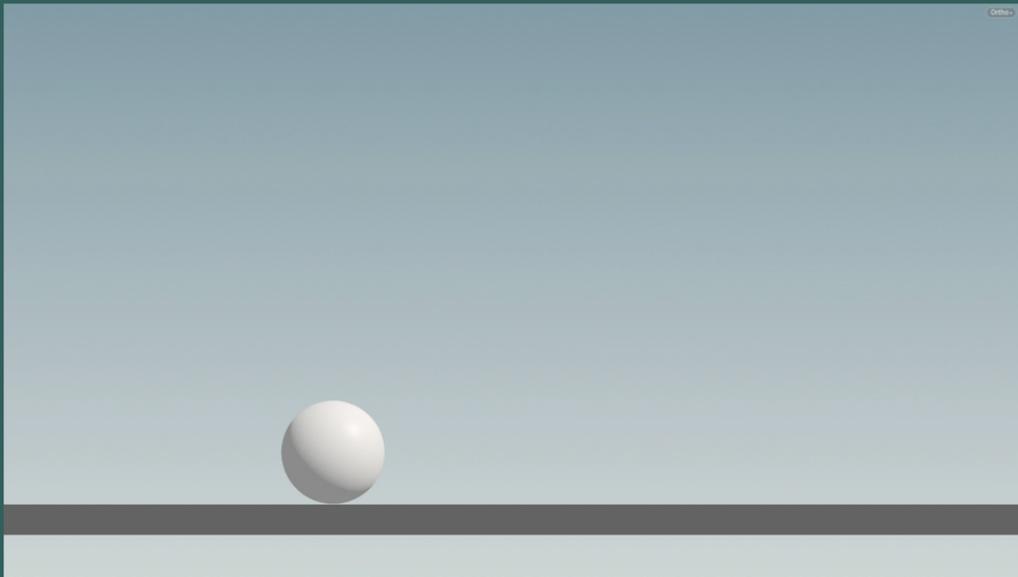
Timing – Timing refers to how quickly something moves, how it speeds up or slows down and how long it stays the same. There are so many different way to change the state of something from A to B. It's about figuring out what your intention is as well as the laws of the world your effect is in. Timing can be applied to movement, colour, contrast or shape. It really is a broad principles and can take years to fully understand.



Principles of Animation – Solid Poses



Solid Drawing/Poses – The original principle spoke of solid drawing which had to do with the draftsmanship ability of an animator. These days with technology at our disposal that's less of a concern BUT we should still be concerned with solid poses – those keyframes that are going to tell the story of our effect. If you're looking for ways to strengthen your animation fleshing out some solid poses can really help. I'll be covering this in more detail later.



Principles of Animation – Exaggeration

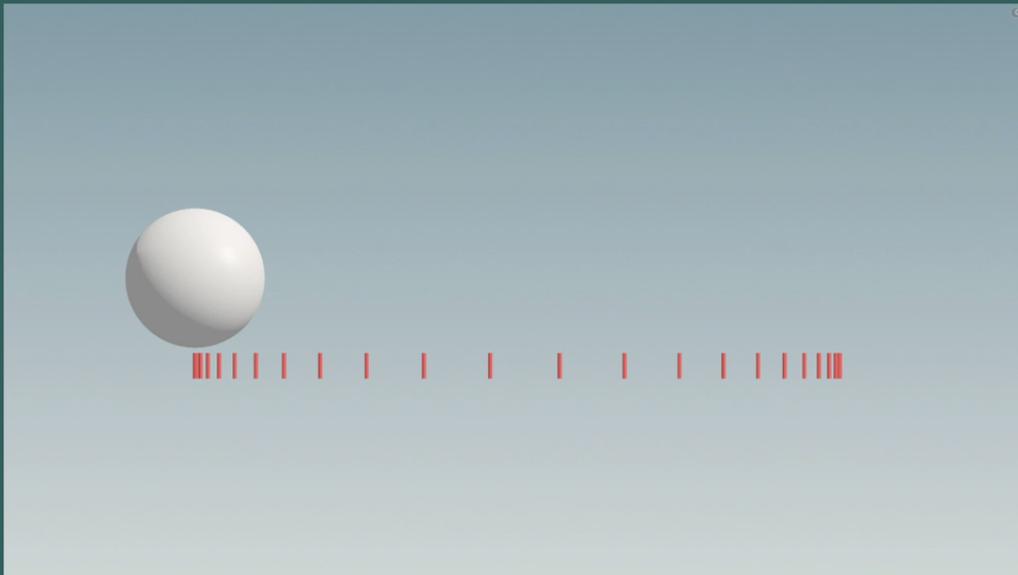


Exaggeration can help draw attention to something. Make an effect more punchy. It can allow you to show the essence of something with less time. Making the final hit in a boss battle bigger to let the player know they're almost there.

What we're trying to do is create more contrast. This principle is something we apply to the other principles. You can see it in anticipation, squash and stretch, timing, arcs, secondary action. The point is when you're looking at a single frame or an effect in a vacuum you're not taking into consideration how that might look in context. We often need to exaggerate to help the idea read better.

When motions are quick, exaggeration needs to be bigger for it to be noticed. Often in games to make an animation or effect work within the gameplay you have less time than you'd prefer. Exaggeration can help make that effect still read in the time available.

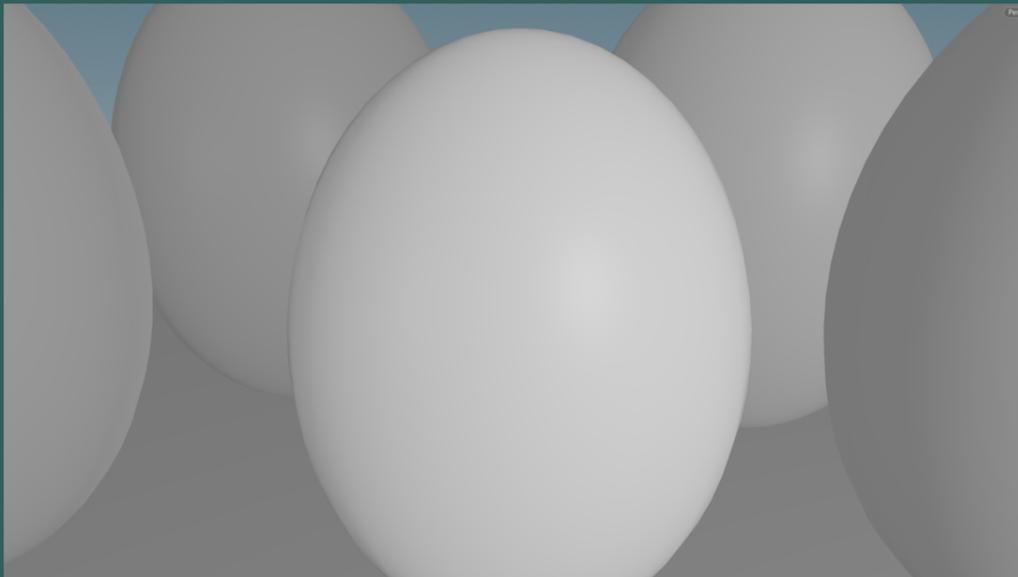
Don't be afraid to over exaggerate your effect. You can always pull back if you've gone too far.



Principles of Animation – Slow In & Out



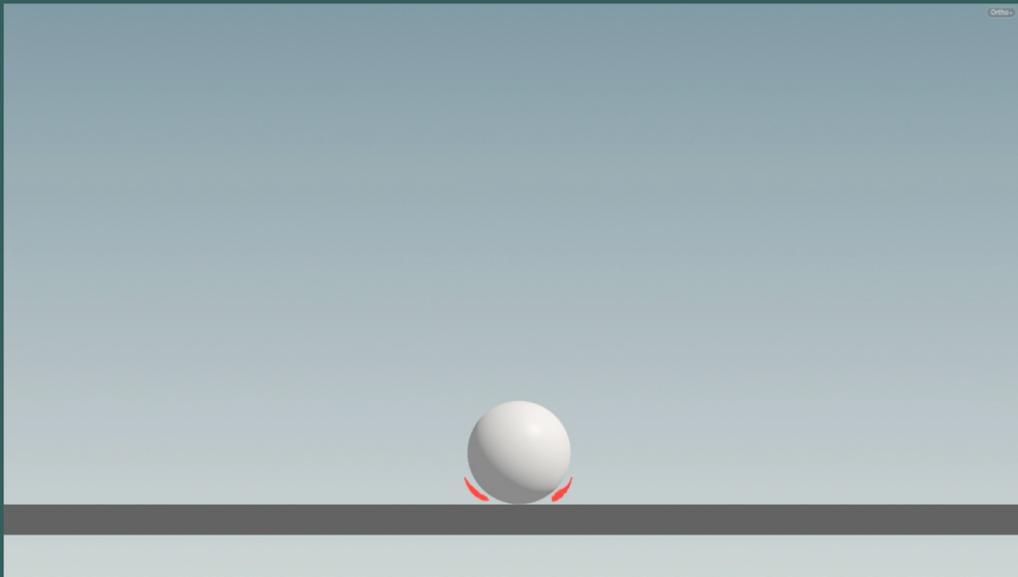
Slow In & Out – The spacing of an animation helps build up and slow down the movement of something. Unless you're dealing with a specific style that requires movements to be robotic most objects will accelerate from rest or decelerate to a state of rest. You can see this in smoke slowing down from an initial blast or the build up to a magical effect



Principles of Animation – Staging



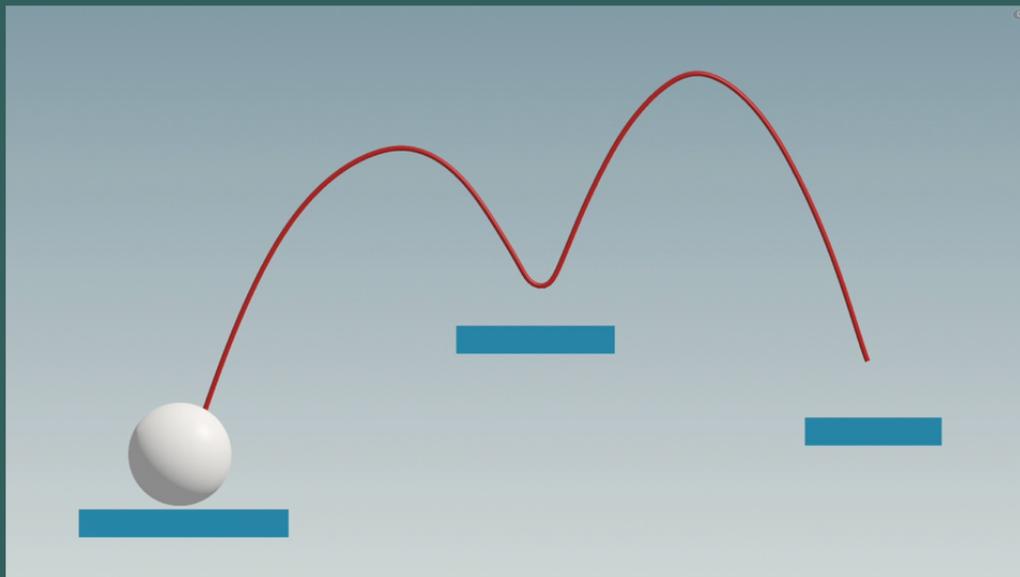
Staging – What should the player be aware of? Staging helps direct their attention. Staging is about balancing the needs of the gameplay with the environment, fx and animation taking place so that the player is focusing on the right thing at the right time.



Principles of Animation – Secondary Action



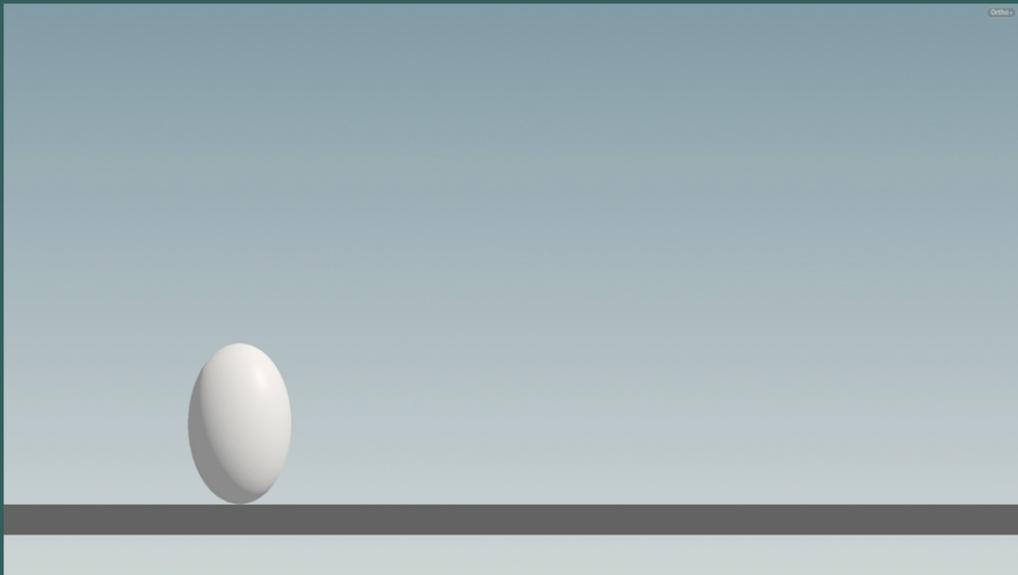
Secondary Action - The primary action of an effect is the thing the effect is about. Secondary action is something else the effect is doing. It supports the main action without distracting from it. When you're making an effect focus first on the main action and then find ways to sprinkle fairy dust in the form of secondary action.



Principles of Animation – Arcs



Arcs – Arcs are a more natural path for objects to move along. They help make movements realistic and pleasing to the eye. Arcs can be found in the movement of fairy dust as it escapes a magical effect or droplets of water from a splash or even the rolling dust clouds from an explosion.



Principles of Animation – Follow Through



Follow Through – Adds realism because the object is following the law of physics. The energy that keeps an object in motion needs to dissipate in order for the object to come to rest. Follow through or overlapping action is an expression of that. You can see this in the licks of fire or a tree being buffeted by a strong wind.



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Layering of Principles

This is just one way to look at these principles. It's not definitive. The stuff that I'm thinking about first and foremost is building a solid base of my effect. I believe to do this I need to make sure I've worked out the timing of an effect. I want to really nail the poses, key frames, call them what you will. Because those are the things that are going to drive the rest of the effect.

Anticipation is so important in games so I want to make sure that I've considered how I'm letting the player know that something is about to happen.

And squash and stretch is the first step in adding life and believability to my effect.

Once I've got my base I can move onto a little more crafting. I want to use exaggeration to push my effect as much as possible while still keeping it believable. I want to make sure that I have some nice slow in and out to avoid the effect looking too robotic. And I want to stage the effect so that I hit the right beats and it fits within my world. And then I want to add any secondary elements, clean up my arcs and add follow through.



Animation of VFX

1. Principles of Animation
2. An Animation Framework
 - Observation
 - Deconstructing Animation
3. VFX Examples



Now that we've got a basic understanding of the principles of animation I'd like to share a framework that I think could help improve the animation of your vfx.

There are 2 things I like to do to better understand the effect that I'm making and flesh out any ideas I have to see what might work and what doesn't.

The first is observation. What can I use as reference to inform my decisions.

And the second is deconstructing the effect to it's simplest form, stripping away the technology so that I can focus on the essence of the effect.

FORTNITE
BATTLE
ROYALE

When creating an effect the very thing we should probably be doing is observing the world around us for clues on how that effect might look. These days there are so many different types of reference. I want to go through my approach to using each type and what I'm looking for.



Garden of Words. Makoto Shinkai, Toho, 2013.

Observation - Anime/Cartoons



I love this scene from the Japanese film, *Garden of Words*. It's so simple but there's so much life in it because of the rain drops. And typical of anime there's an economy to the animation. I've tried to do rain splashes in the past and I always overcomplicate things. I want to do a fluid sim and extract the crown splash. Or I'll generate a static mesh from the crown splash and then try and animate the scale of that over time. And that's definitely one way to approach it. But I get lost in the technology instead of focusing on what makes a splash a splash. Which I think is about solid poses, good timing and some nice squash and stretch.



Garden of Words. Makoto Shinkai, Toho, 2013.

Observation - Anime/Cartoons



UBM

If we take a step back and look at this reference, each splash has 5 or 6 frames that make up the main idea. There's some nice squash and stretch as the rain drop hits the water and we move into the follow through. There's some great secondary action in the ripples emanating outwards from the point of impacts. And the poses are strong enough that we can follow all of this happening in a fraction of a second. It's strong and concise.



7



8



9



10



11



12

Garden of Words. Makoto Shinkai, Toho, 2013.

Observation - Anime/Cartoons



And then to add some flavor there's a second phase. This could be considered follow through, secondary action, dissipation.

I could use this information in a number of ways. If it's a 2D game I can get a way with a simple 2x3 subUV texture or with a bit more effort create a mesh for each keyframe and loop through them. I'm more likely to hit those shapes than if I were to just scale a single static mesh or sprite. As always it really comes down to your game, the time you have and the balance between art and performance.

The point is I really like looking at cartoons and anime for vfx because they often show you the keyframes needed to make your effect and then you can elaborate on top of that if you want to.



Skyfall. Sam Mendes, Daniel Craig. 2012. Metro-Goldwyn-Mayer, Sony Pictures, Columbia Pictures

Observation - Live Action



I have to give credit to Stu Maxwell at The Coalition for helping me use film reference better. Just like cartoonists have mastered their craft, film makers have been making effects way before the computer came along. And the thing that movies are good at is exaggerating an effect so that it reads clearly and feels more dramatic. The sparks and smoke that are given off by the impact of the bullets are so over the top but they work for the scene and the type of film. The staging of the shot makes sure that you can clearly tell who's being shot at, that the bullet impact is the most important thing in the shot and it's placed on a background that helps the smoke and sparks read clearly.

I try and find reference that is similar to the game I'm making in terms of feel which gives a good starting point.



Gigantic. Motiga. 2017.

Observation - Video Games



There's so much good stuff in the effects of Gigantic. They've taken a graphic style and made it work within the context of a game. What I mean by that is that we don't often have the time to anticipate an effect. As soon as the player presses a button on the controller there needs to be a response on the screen. They do this to great effect with the swipes and swishes. The long trailing lines help lead our eye to what just happened without the need for any build up. The colours and shapes and movement are all exaggerated so that they're as clear as possible in the short amount of time they're on screen. There's some great touches to support the main effect in the secondary actions. My only gripe is that the staging could be better. At times, there's so many different effects happening on screen that it becomes visual overload. Compare this to a visually similar game like Overwatch and you'll notice that the action reads a lot more clearly even when there's a lot going on. Video games can be good reference but be careful not to limit yourself by the limitations of another game. We don't always know why an effect was done a certain way in a game. It may be due to the game engine or the target platform. It may be the amount of time an artist had to spend on an effect which means the effect wasn't polished or refined enough to be analysed because it was seen as a lower priority in the bigger picture.



The Slow Mo Guys. "Melon Fragmentation at 2500fps" Youtube. Youtube, 21 January 2014

Observation - Slow Motion



Slow motion videos and home videos are great for picking out details. Analysing the underlying structure of the forces that effect the movement of something or picking out interesting details or shapes. I would use this kind of reference to add secondary, supporting elements to my effect but I'm not going to use it for timing and only a little for shape information. That's because there's almost too much information now and it can be tricky to extract what's really important when slowed down this much. So what is It good for? Sometimes things move so quickly it's difficult to separate out the nuances of some secondary action to support the main action. Arcs can be clearly defined when you can watch something moving really slowly.



Observation - Home Videos



There's an entire community of youtubers who will gladly film themselves with different weapons and the effect those weapons have. I think this kind of reference is great for working out the specifics of an effect. How does the muzzle flash of one weapon differ from another? What about modifications to the weapon? Does that change the movement or shape of an effect. Something I always try and keep in mind though is that these videos are generally shot with consumer grade recording equipment so the shutter speed could have an effect on what we actually get to see. Also, the environment isn't staged the same way a movie might be so lighting and background influence how we perceive the effect. Keep these things in mind when analyzing the footage and be careful not to extract information which is specific to the situation and might not apply to the goal of your game's effects.



Skyfall. Sam Mendes, Daniel Craig. 2012. Metro-Goldwyn-Mayer, Sony Pictures, Columbia Pictures

Observation in practice - Fire



Since we're talking about observation and reference let's do a little exercise. I want you to take a moment and look at this image of fire from the movie *Skyfall*. Now I want you to imagine how that fire would move. Okay? Have you got that scene playing in your head?

This is what it looks like. Now ask yourself, was your idea of how quick the fire evolved faster or slower than what's on screen at the moment? I would venture that we generally playback fire slower in our imagination and that often translates to what we see in games. I think this is a common mistake, especially for less experienced artists. The effect feels too slow because you haven't checked it against some kind of reference or asked a colleague to take a look. See how quickly and erratically the shapes change? At this frame rate the camera is only capturing a fraction of the movement. This comes back to the idea I mentioned earlier about how to use different pieces of reference and what to analyse in each. If we were to look at a slow motion video of fire you would see the beautiful fluid dynamics that make up the movement. But when we play it at a more normal rate it has a very different feel. It's fast and erratic and I think this gives it an energy that is important. So think about what the purpose of the fire is and what kind of movement you should be aiming for.



Observation in practice - Fire



If it's a more realistic fire you're after then capture that energy. I've seen a lot of fire in games which look quite nice but they feel laboured. Like they could double the speed to get closer to what you might find in reference. I'll find multiple references that match the look and feel I'm after and then constantly refer back to them as I iterate on my simulation.

With something like timing you generally have a range you can work within – somewhere between believable and exaggerated is a sweet spot and that depends on the effect, reference and your game.



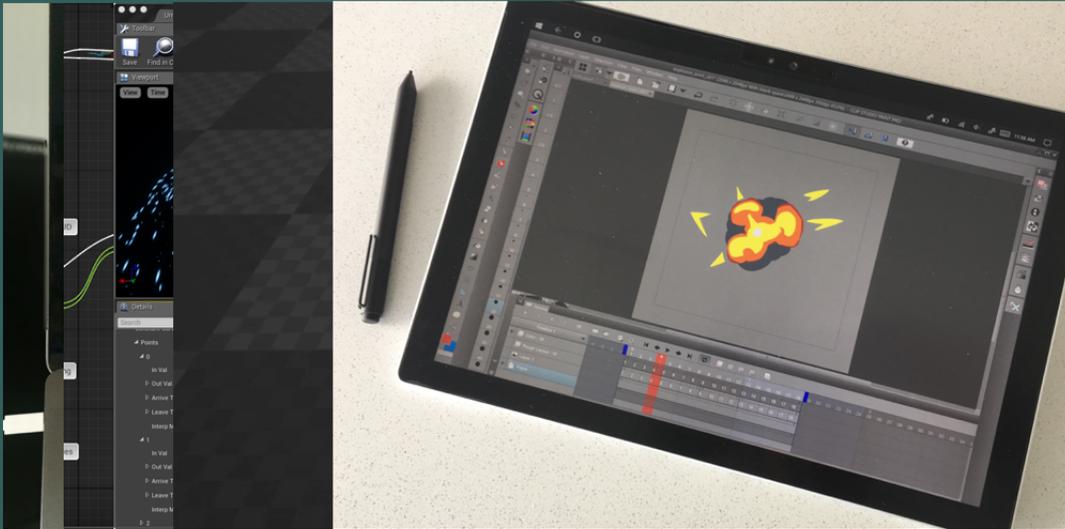
Klemen Lozar. "Fire Test" Tuatara Games. @klemen_lozar, 2017

Observation in practice - Fire



This doesn't just apply to simulations. In this example Klemen Lozar uses nothing more than some panning noise textures and some clever shader tricks to create fire that feels alive. It has a good sense of shape change. If you want something which is a little more stylized but still believable you can do that and keep the intention of the reference.

So that's reference and the kind of questions I ask when I look at different types. Now that I have a bunch of notes about my effect where to next?



Deconstructing Animation



Normally at this point I would fire up my game engine.
[CLICK]

I might have to do some basic or not so basic scripting to hook up the logic of the effect to the game. [CLICK]

Then I open my particle editor and I have to start creating emitters, changing various number and playing with animation graphs. [CLICK]

And all of that to get to something simple like this. That's a lot of steps between the idea and a first pass of the effect.

So what I've been trying to do more recently is step back a moment and use the simplest tools possible to flesh out my effect. And that still happens to be pencil and paper. Now, the cool thing is tablets and stylus' have become more common, and most 2D packages have some basic animation functionality so you can do this next step on your tablet or computer.



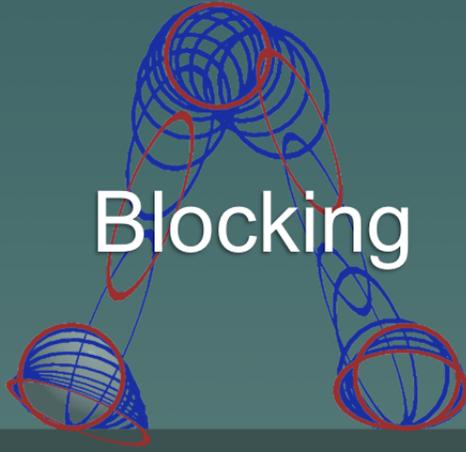
Deconstructing Animation



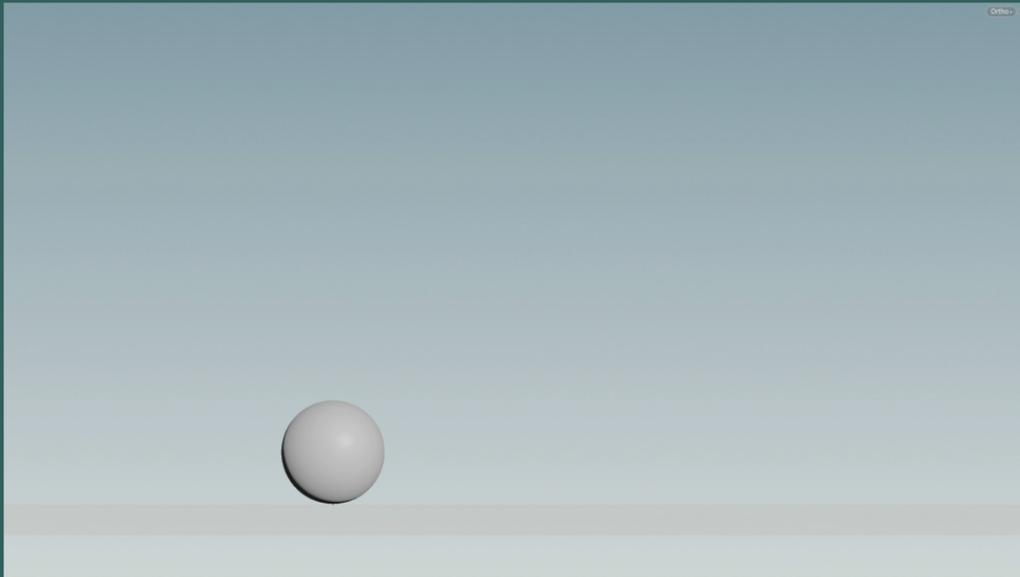
I want to look at breaking down an effect to it's simplest pieces. I think you can use this as a learning exercise if you want to strengthen your animation skills or as the building blocks for most effects that you make.



Blocking



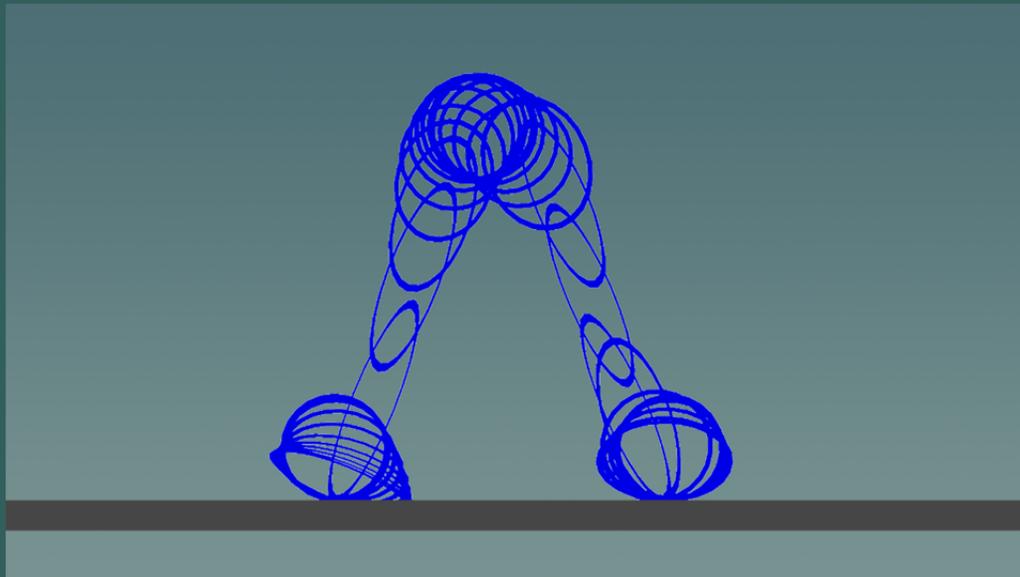
This is one approach to deconstructing your visual effect. In traditional animation this refers to blocking.



Blocking– Original Animation



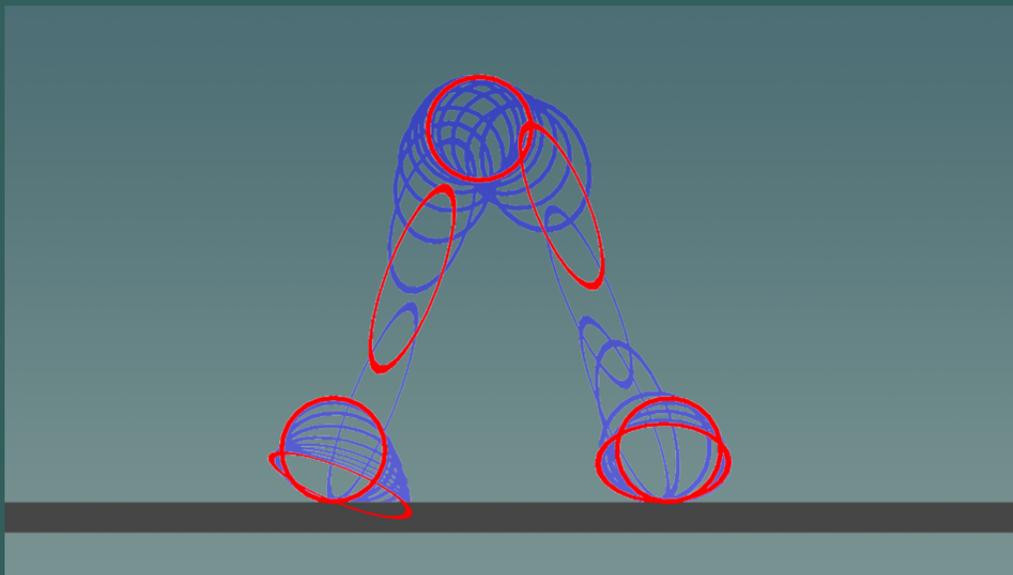
So let's revisit an animation I've already shown. This was the jumping ball I did to show the principle of exaggeration. Now let's deconstruct it to find the essence of the animation.



Blocking - Onion Skinning



I've taken the outline of each frame and overlaid them. I want to take a step back and see the whole sequence. That way I can see the relationship between 1 frame and the next. There's a lot to try and take in here. In fact, I think this is why it's important to deconstruct. So we can remove the unnecessary information.



Blocking - Keyframes

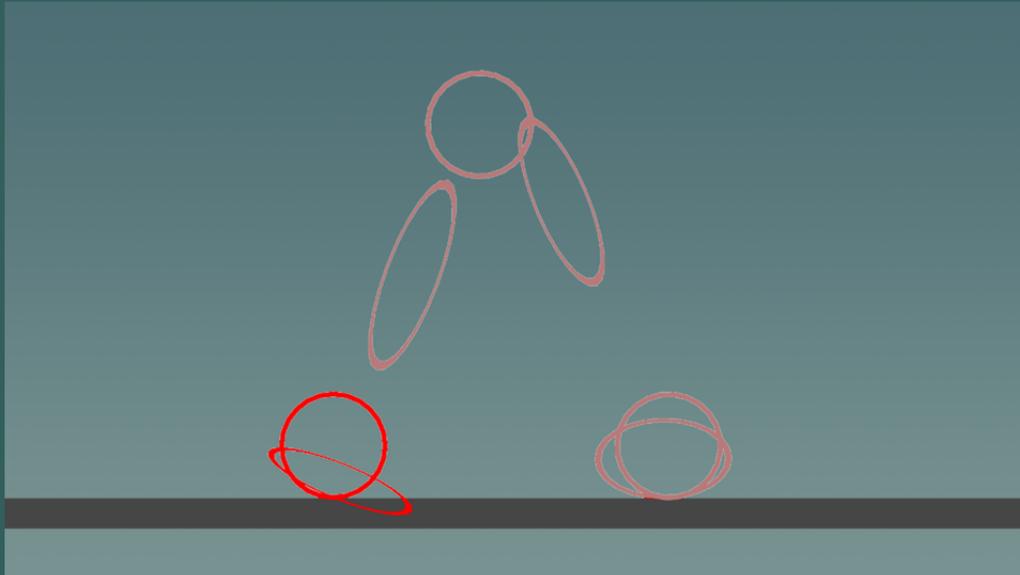


If I was to identify the most important frames. The ones that described the most information in the most economic way, these are the frames I would pick. Remember, it can be different for different people but the underlying principles are still the same.

I like to try and limit myself to 4 or 5 frames so that I don't get lost in the details.

[CLICK]

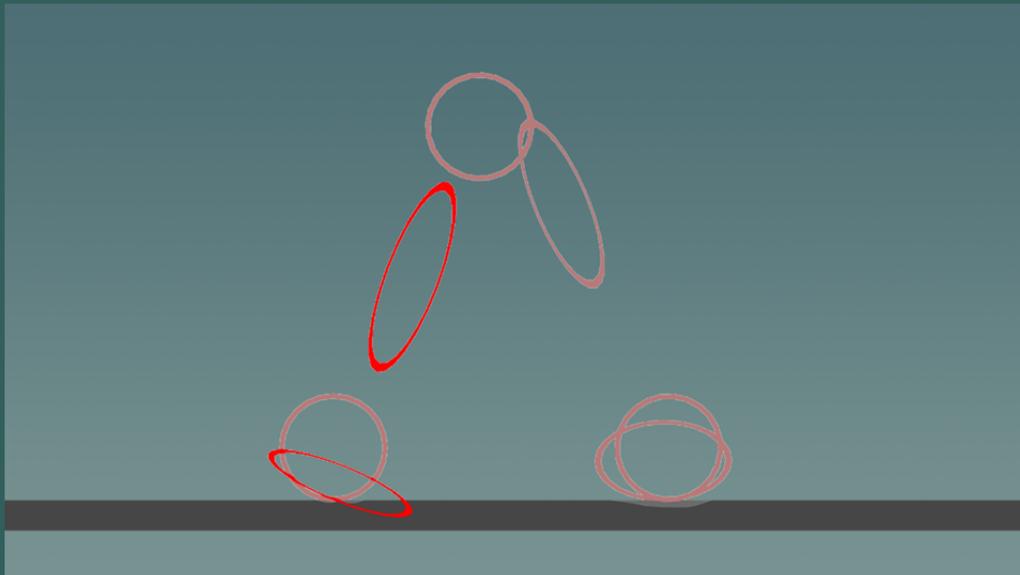
If I remove the original overlay I'm left with something that is a lot easier to read and now we have something to play with.



Blocking - Anticipation



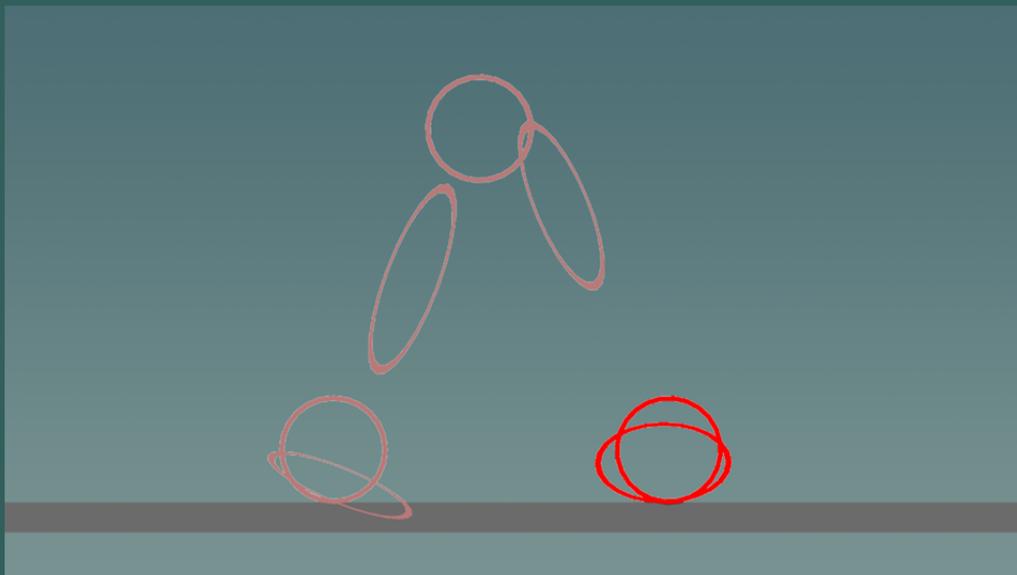
Anticipation - From these 2 frames I can describe the anticipation of the ball as it prepares to jump up.



Blocking - Squash & Stretch



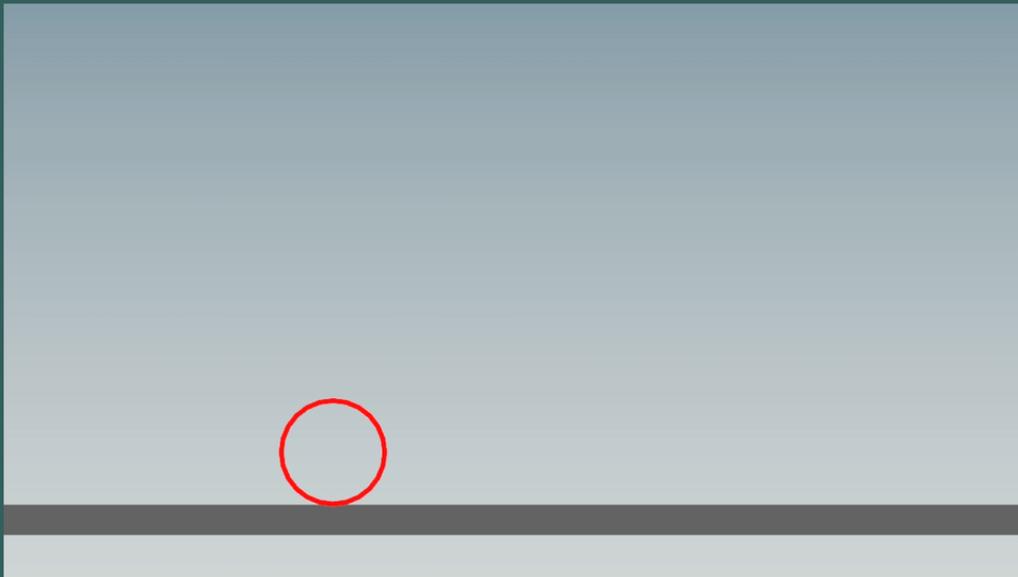
I can describe the squash and stretch the ball will go through to reinforce the anticipation as well as the speed towards it's apex. And then I could do the same as the ball comes back down.



Blocking - Overlap



And then finally I can show that the ball has some energy which it needs to dissipate as it comes to rest by creating a little overlap through squash and stretch.

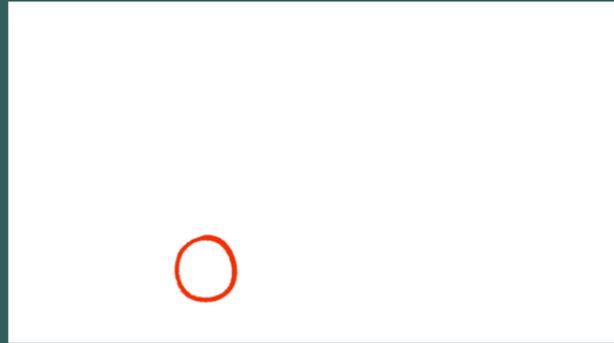
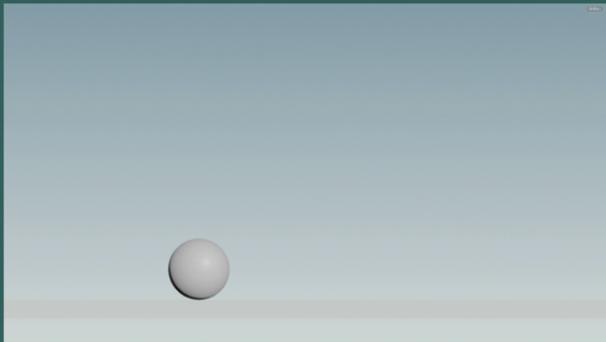


Blocking



If we put all of that together then we now have something which describes all of the necessary pieces but it's lightweight so I can easily add or remove frames, move them around to see what timing might work best without being bogged down by all the controls in your particle editor. In my mind I'm playing the animation using the keyframes to guide me. I'm filling in the gaps in my head and asking does it feel right?

What I like about this technique is that allows me to distill down the essence of the effect making it easier to focus on what's important.



Blocking – Strengthen the idea



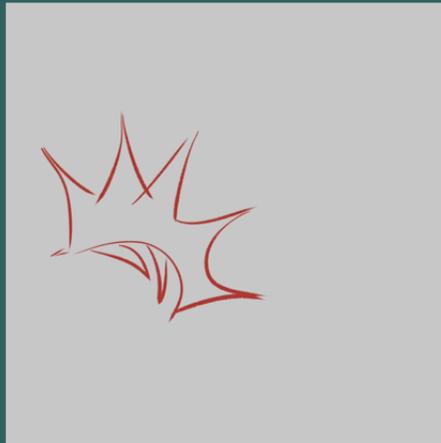
I want to take this one step further. Up until now I've been using 3D tools to express and animate this jumping ball. I wanted to create an example for the solid pose principle so I took the animation into my 2D package and basically did a quick paint over of what I thought were the key frames. I'm still looking to have as few frames as possible so it's easy to make changes and not get caught up in the details.

These sketches are the building blocks going forward. By limiting the number of frames I have I can quickly iterate on the look as well as the timing, moving frames around until I find something that works.

The other thing I did was to see if I could push the poses so, I added some bend to the squash. I tapered the stretch. And I chose to push the stretch on the way down a little sooner. This all took me a couple minutes and because I'm no longer limited by the rig in the 3D package I can push things a lot further.

I think this is why we should be using 2D sketches and animations more to get the most out of our effects before committing to the game engine. I've seen quite a few animation and film studios provide a way for leads and art directors to quickly sketch over a frame. It's a great way to provide direct feedback and gives the artists something they can take back to their desks as a guide.

Now, I must warn you. If you came to this talk expecting beautiful sketches you're in the wrong place. But in the spirit of learning I'm going to show some of those bad drawings.



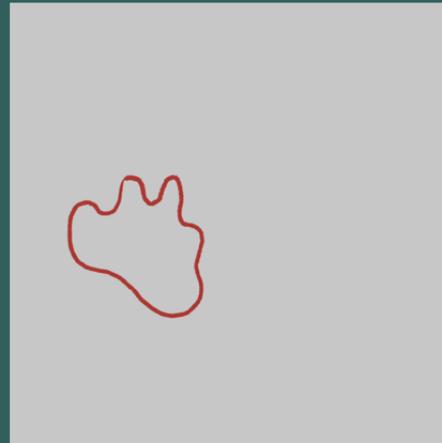
Blocking – Blood Splat First Pass



Okay. No more bouncing ball animations. Let's see what this looks like with an actual effect. I copied a blood splat effect done by Pedro Medeiros – he's a pixel artist who also has a great patreon page. My goal here is to get a feel for the timing of the effect while applying the different principles and seeing how they can work together. Fluid simulations can be tricky to setup and extremely time consuming to craft. All I care about for now is creating a guide for what I want.

I want the blood splat to have a strong beginning. I want to see the force and break up as it evolves. And I want it to dissipate in a way that makes sense for the fluid as well as gameplay.

I've picked 5 frames and now I'm going to start playing with where they sit on the timeline and making changes to test my ideas around the different principles.



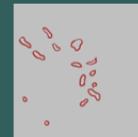
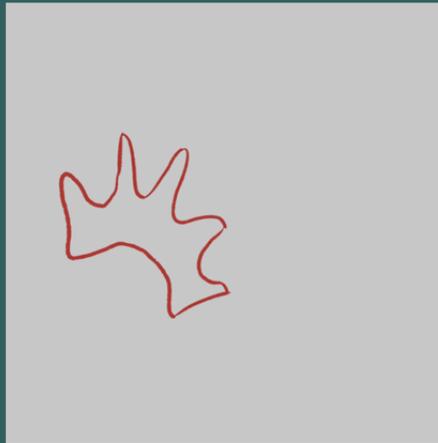
Blocking – Blood Splat, Playing with timing



My first thought was that it might be too quick. So I tried holding the last frame for a little longer to see what that would feel like. Think of it like a slow-in. There would be a big burst of blood and then I'd exaggerate the hold of the droplets in the air.

I also wanted to see if I could add some more squash and stretch at the beginning by starting with a more blobby type shape that had an outward force leading to the spikes.

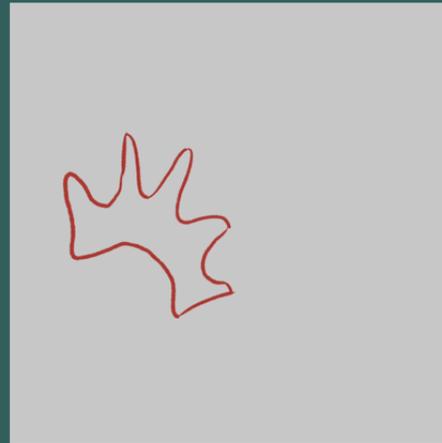
But instead of strengthening this effect I had weakened it. I'd made 2 common mistakes. First it was too slow now. The hanging at the end just draws the splat out too much. And the other common mistake, especially with explosive type effects, was that I was taking too long to get to the good stuff. My brain was imagining how the blood would start as a ball and evolve into this interesting shape but all I've done is added another beat to the beginning of the splat instead of going straight into the splat which is the main idea.



Blocking – Blood Splat Refine the Timing



So let's do another round of tweaks. I still want to get some squash and stretch at the beginning, because I'm stubborn sometimes, so I'll drop the initial frame but keep something which is a little more blobby. And I'm still playing with the idea of a slow out for the dissipation. I did this by holding the second last frame instead of the last one. And I think this works better if my intention is to exaggerate the droplets hanging in the air.



Blocking – Blood Splat Final Pass



But the more I play it the more I feel like the timing is too slow. A blood splat should be snappy. I chose to go straight into the big shape and then have it dissipate. The exaggeration in the dissipation wasn't working for me. So there we go. In a short amount of time I've managed to iterate through a number of ideas.

I now have a better idea for the timing of my effect.

What kind of shapes I'm looking to hit. How I want the blood to dissipate.

And how much secondary action I can add with some extra droplets.

I'm using this to explore what might work for the final effect in game. That could mean doing a fluid simulation. Or in-betweening these frames if it matches the style of my game. Or using this as a basis for animating static textures in your particle system.

At least now I have a guide to refer back to that was quick to produce and focuses on the essence of the effect.

Did I mention it was fun?



Animation of VFX

1. Principles of Animation
2. An Animation Framework
 1. Observation
 2. Deconstructing Animation
3. VFX Examples



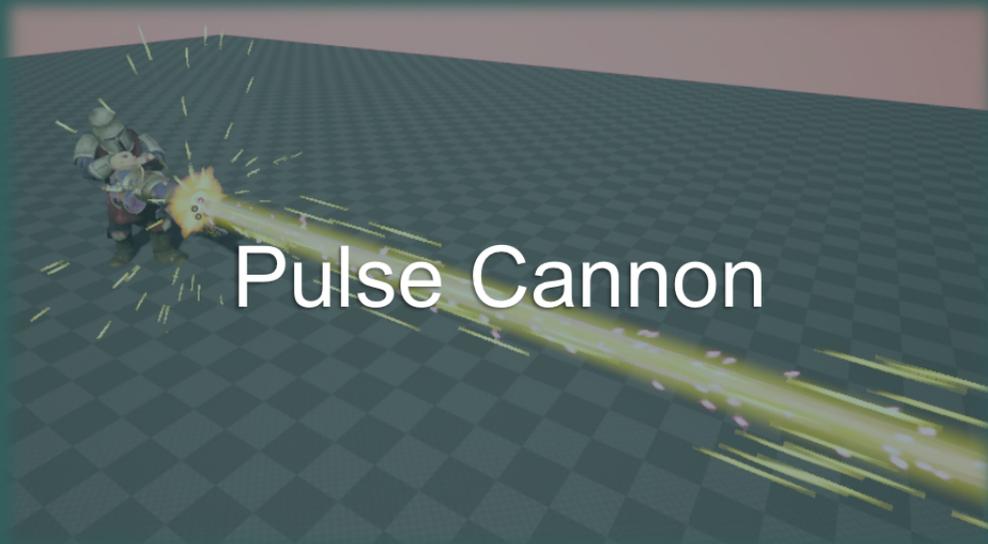
That's the framework for how I approach a lot of my animation these days. I gather a bunch of reference and pick out key ideas depending on the type.

And then I try and deconstruct the animation to its simplest form so I can focus on what's important. I strip away the technology that can get in the way of the idea.

I should also point out I focus a lot on changes in state when I'm creating an effect. My brain is more comfortable analyzing movement. That means I'm weaker on the design side and I often rely on the help of other vfx artists to make sure that that part of the effect isn't lacking. Great movement with bad design or colour choices is still bad.

[CLICK]

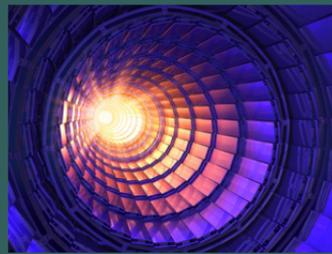
Now I want to show you how this applies to some specific effects I've made. I'll take you through these same steps, talk about some common mistakes people make. And by people, I mean me. Hopefully you'll see the principles popping up throughout this.



Pulse Cannon



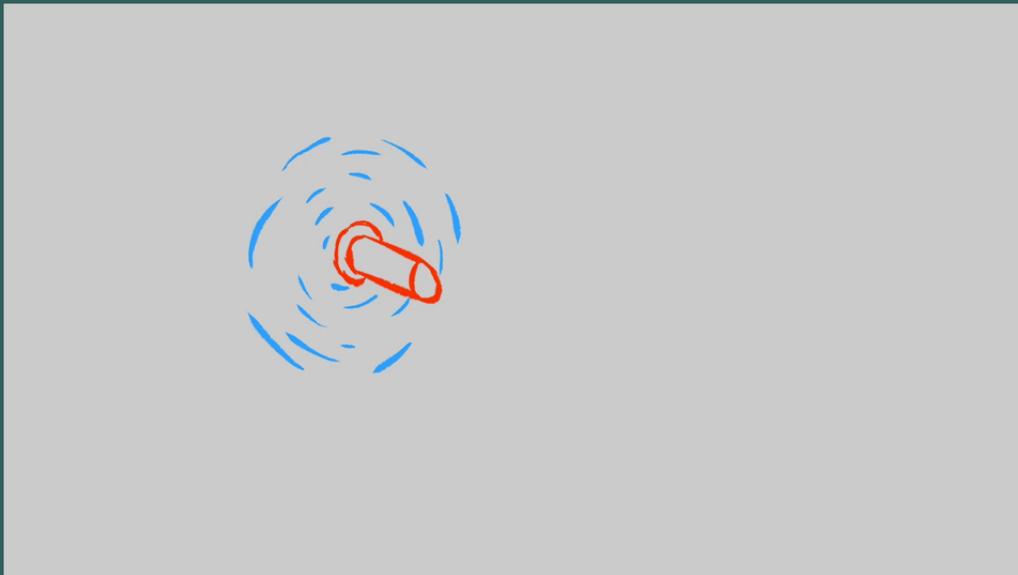
Let's look at a pulse cannon. This was issued as a challenge on the realtime vfx forums a while ago. I think it's a great exercise to practice the different principles. There's the anticipation as the cannon builds up. There's the release of the energy and then the dissipation. And in each of those phases there are different principles that we can apply.



Pulse Cannon -Reference



I find as much reference as possible and start isolating the things I like. Not necessarily elements (but that too) but the feeling and how things works in concert. I start playing my own version of the pulse cannon in my head. I will do the hand waving and sound effects and then time that out.



Pulse Cannon - 4 Frame Test



This was my first pass at what the 4 frame test for the pulse cannon might look like. Now, a common mistake I see often is not figuring out the story of your effect before hand. I want to make sure that I'm clear about what's going to happen in the beginning, during the main phase, and how it's going to end.

This is a simple sketch but it gives me a lot of information. I want a good build up in the beginning to create some anticipation. I'm keeping in mind how I can use squash and stretch in the beam to go from the anticipation to the main action. This is light weight enough that I can quickly play with the timing of all the elements at the same time. I also try and flesh out some of my secondary actions, both in the build up during the anticipation as well as adding some extra elements to the release of the pulse cannon.

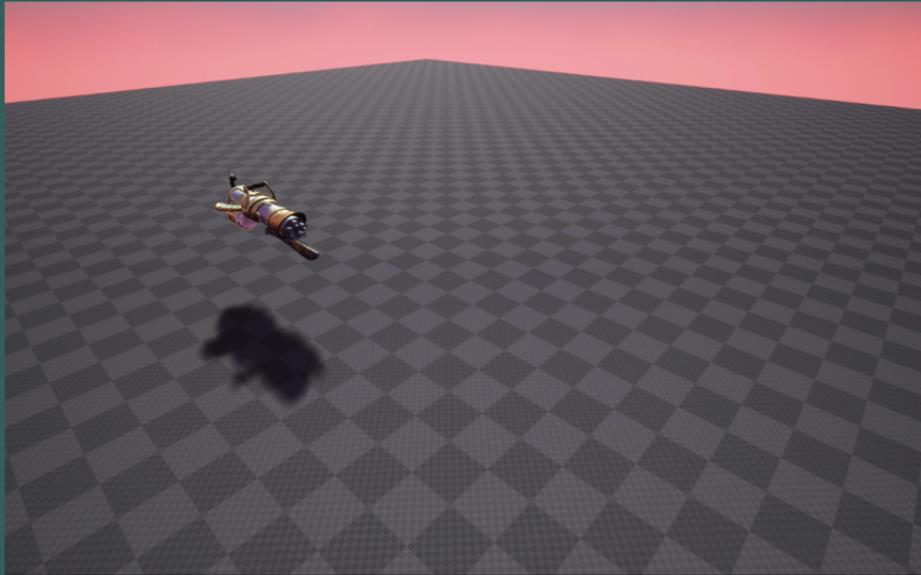
I'm generally too conservative when I create my effects. I often don't push things far enough and when I've already spent a day working out an effect in the editor I'm less willing to make wholesale changes to push things further. At least at this point I can really exaggerate things without worrying about it because it's quick to change.



Pulse Cannon - 4 Frame Test



Once I've got a lot of my foundation worked out I'll do another quick pass to offset each element. This is kind of like a secondary timing pass. It also allows me to work out some of the details of the slow ins and outs.



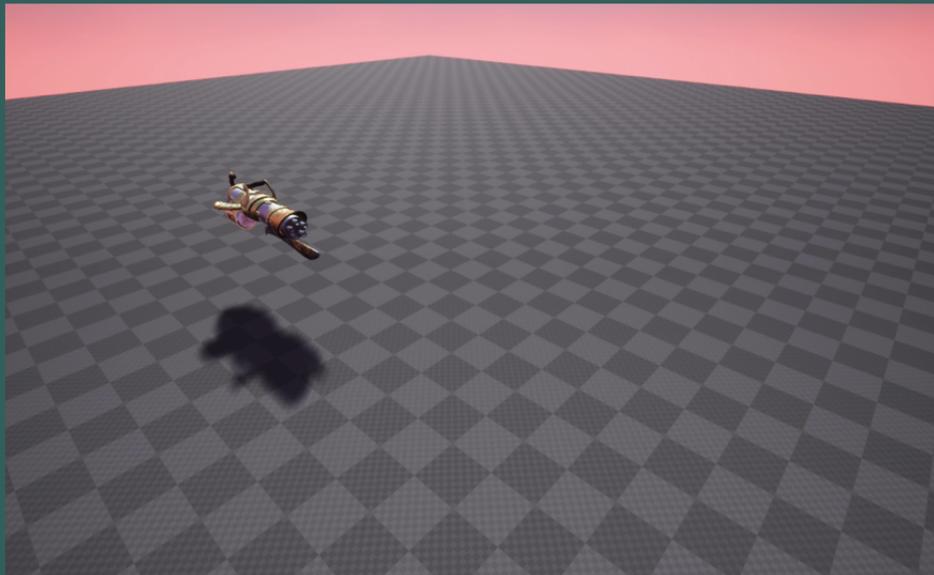
Pulse Cannon



So, this was my first pass at converting that blocking into something in the editor. I think it translates pretty well. I've hit all the basics and now I can start looking to pushing it further.

Some of my initial thoughts included wanting to add more contrast. I also wanted to strengthen the phases and the idea that this beam is powerful.

I noticed that the anticipation and transition from the build up to the release felt a little flat. I wanted something more punchy.

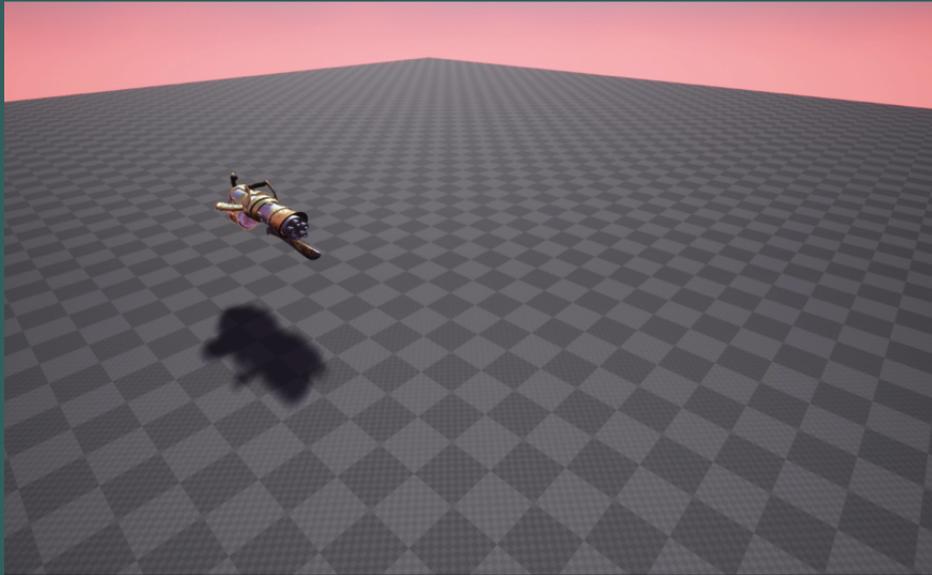


Pulse Cannon



So I started tweaking the relationship of the elements to each other with that idea of creating the anticipation before the pulse cannon fires.

I also retimed the speed of the main beam and its secondary particles to improve the contrast.



Pulse Cannon



The more I played this back, I realized that the transition from the anticipation to the beam wasn't working because I was trying to do squash and stretch in the beam itself. I was being too literal in the idea. So I removed the initial squash in the beam because the anticipation would still read in the other elements. And I added some particles floating in the air where the beam would eventually fire so that the player knows where to expect danger.

Now when the beam fires there's a much stronger impact. This is similar to explosions or blood splats where having a very quick state change can make it feel really intense. I also started adding some more secondary action. I wanted the beam to feel like it had all of this raw energy and it was barely being contained within this narrow focus. I added particles that would "escape" from the core.

Something interesting happened here. I had envisioned these particles following the flow of the beam and then breaking off in a nice arc. What I found was that I couldn't easily direct the particles either due to a limitation in my knowledge of the particle editor or a limitation of the editor itself. Either way I had to make a decision that I wasn't going to get arcs in the particles. So I focused on the other principles to make sure it still worked.



Pulse Cannon



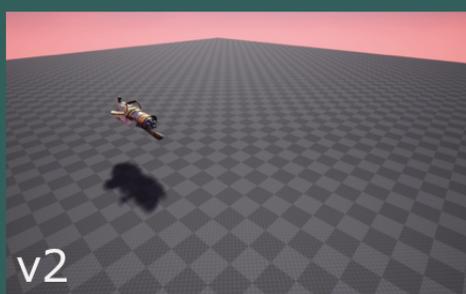
At this point I was pretty happy with the effect. I showed it to a couple people to see if I was missing anything and then started tweaking finer details.

I tightened up the timing not only in the movement but also in the colour changes happening in the beam and the secondary action particles.

And then I upped the contrast in the beam.



v1



v2



v3



v4

Pulse Cannon



So even after I've worked out the details in the blocking phase I'm still thinking about the principles and how to apply them as I get closer to a finished effect



Context

I want to take a brief detour to talk about context. I've often made this mistake. I spend way too much time refining an effect in a greybox level and then when I put it in the game. Well...





Context - Greybox



Here's that pulse cannon effect applied to a cannon but in a grey box.

See, a lot of timing decisions are made in a vacuum. There's nothing wrong with starting out making your effect in a simplified environment. But as soon as you can get that effect into the game so you can see the relationship between the environment, gameplay and your effect. What I'm looking at at the moment is only half the story.



Context - Full Level



Here's that same effect in the game with the environment and the characters.

Now I can actually see that effect in context. Besides the need to check for performance it's important for seeing how it fits in the world. It might look great on a grey background but how does it play when compared to the pace of the game and in relation to the environments and characters.

Does the anticipation work when there are other things going on in the level? Is it still clear to the player?

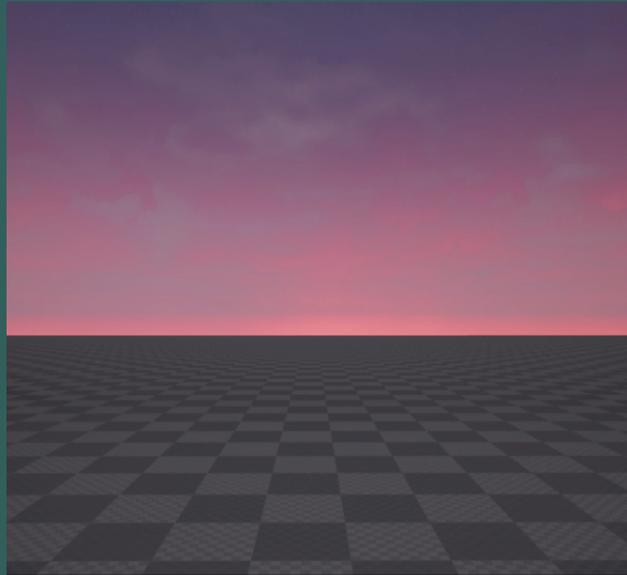
What about the timing? Can I get away with my effect taking as long as it does to build up or do I need to shorten it to match the weapon animation.

These are the kind of questions that are best answered with the effect in the game.



Explosions. There are so many different ways to do an explosion. If you're working on mobile you have to find ways to use 2 textures to create complex motion or if you're working on a AAA title you may be creating advanced fluid simulations and converting those to texture sheets.

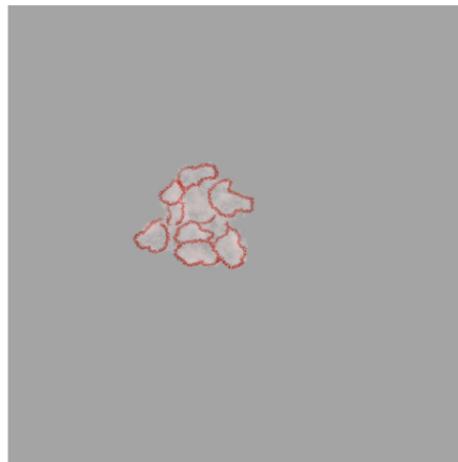
Regardless, the principles still apply and you can still block out your effect before jumping into the editor.



Explosions



Okay. Confession time. When I was putting this talk together one of my ideas was to show an explosion and talk about how getting to the good stuff can improve the feel of the explosion. The whole idea was based around running a sim and then showing the difference between the full sim and starting the animation 7 or 8 frames later when the explosion had already evolved a bit. I spent a number of days crafting this beautiful simulation, making sure that the shape was relatively uniform so that I could reuse it, making sure there was some nice rolling smoke and a strong sense of combustion. I was honestly going to present this slide as is and say, "see! Look how much better this explosion looks when you skip forward a couple frames" and call it a day. So I showed it to a couple people and the response I got was, "cool explosion... where's the rest of it?" I'd been so focused on this one aspect of it that I'd disregarded all the other elements that make a good effect. I think this is a common mistake that some vfx artists can make. We get so focused on one aspect of an effect that we never think to flesh it out. This isn't an effect. It's just the starting point.



Blocking



So, let's go back to this idea of blocking out your animation. That's my foundation. So what I did was I brought the sequence into my 2D package and I did a very quick paintover. I picked out what I thought were the 4 or 5 important frames to describe this explosion because even though it looked pretty good something didn't feel right. And there was so much going on in the render that I was struggling to pick it out. So I want to deconstruct. Go back to basics.



Blocking



This is that exact same paint over from the previous slide just without the rendered explosion in the background and immediately I could now tell that the overall shape was too uniform. It's too slow. And the original sim has multiple beats in the internal details but it's pretty slow and consistent overall. And this is also another common mistake. I do it myself. I've seen other people do it as well. It's not taking enough time to nail the initial timing before jumping into the finessing. You might have all the beats but they're laid out in a very even manner. And instead of taking the time to get the timing right we move straight onto adding elements and finessing details. And then you just have more stuff which looks okay instead of getting the initial core really really strong.



Blocking – fixed the timing



So? What did I do? It needs to be an explosion. I gave it a strong start. I made sure that it really gave a lot of energy moving out as quickly as possible and then it eases out towards the end. So now we've got something, which to reference, Jason and Hadidjahs talk has a very high intensity to begin with and that fades off over time as we go to the end of the explosion.



Blocking



Remember how I said that was just the first piece? Well I need to add other elements.

I need to break up the shape.

I need to add in some contrast.

I need to add in some secondary action. And so I started playing with some other elements. This was all done by looking at reference and in this case I thought I would do something like a Michael Bay explosion. He loves having these big badass effects with a lot of practical effects. There are almost always streams of sparks and these really cool smoke shapes that come out of it.



Blocking



And then I took that one step further. Just like the previous example. All the layers keyframes are on the same frames. What I've done here is I've gone over each layer and I've just played out the timing slightly differently. Timing can be so tricky to nail and when there's multiple elements it's even harder.

So my blue smoke puffs are now dissipating at a different rate and deforming at a different rate.

My sparks are pretty consistent but they've got a nice arc to them and they dissipate kinda quickly.

I know I'm probably beating this dead horse but it's so much easier to do this with sketches than it is to try find the right material and texture and hook up the emitter and then try and change the timing on multiple emitters while keeping an idea in my head.

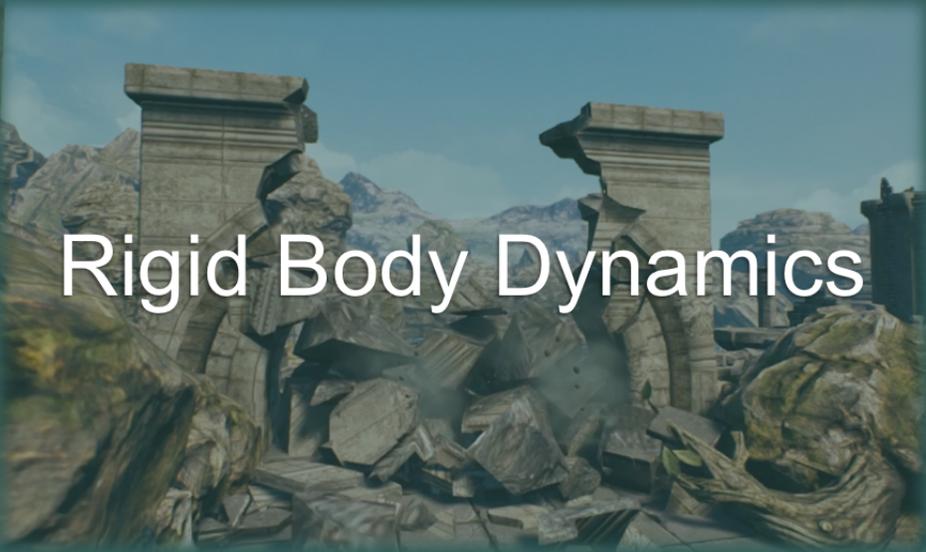


Explosions



So we've gone full circle. I started with a simulation and render. Went back to a 2D package to strengthen my ideas and add any extra elements. And then went into my particle editor with that same initial explosion but a much better idea of how I was going to execute. There's still work to be done in the editor but at least I have something to refer back to. I almost feel like I can focus on the making of the effect rather than thinking about it.

Something I haven't spoken too much about is staging. When I showed this to Andreas Glad he mentioned that the explosion didn't have any beats. It was just a simple boom. Instead of b-boom. In other words, could I create a micro-anticipation that sets the stage for the main action. I spawn the initial explosion sprite and then almost immediately after that spawn 2 or 3 smaller explosion sprites that move outwards very quickly with a lot of drag. It adds another level of interest to the explosion.



Rigid Body Dynamics



I don't know how many people think about the principles of animation when they're setting up rigid body simulation. The principles are not limited to 2D effects or particle editors. They can also be applied to these guys.

When I'm looking at a rigid body sim I'm trying to find ways of adding contrast which is a catch all for:

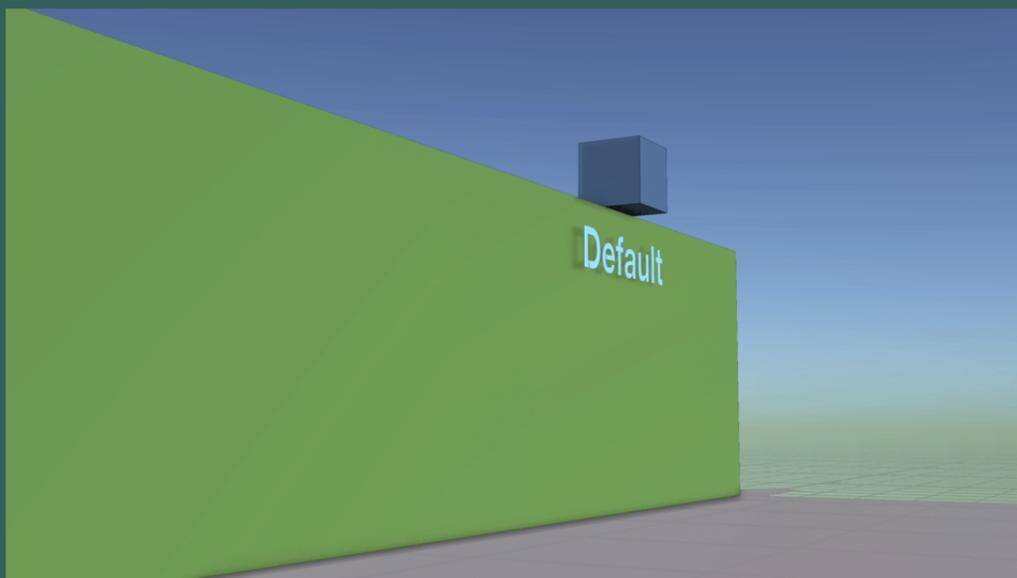
Squash & Stretch

Timing

Exaggeration

Weight/Scale

But you'll see that the other principles can also be applied.

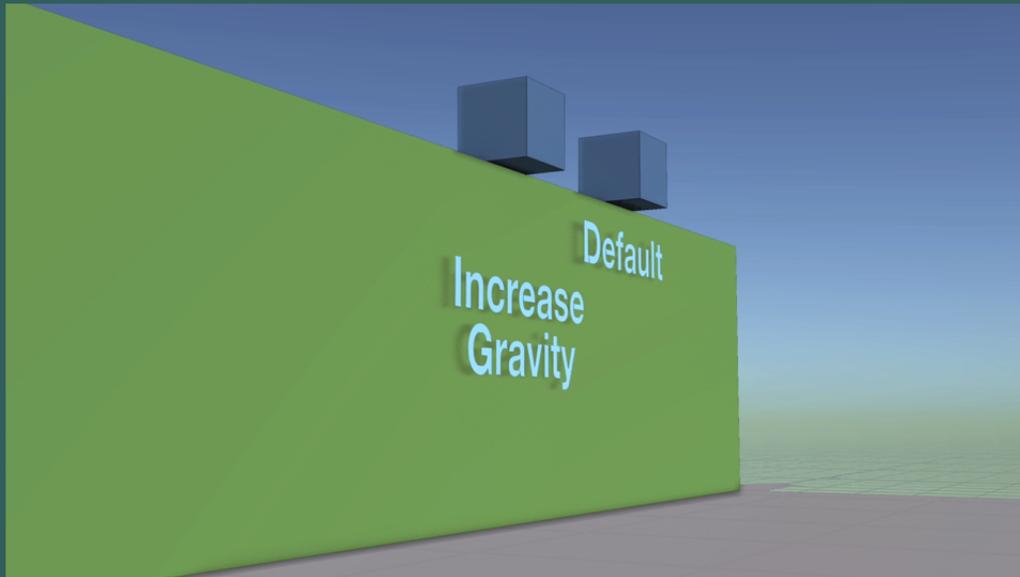


Timing & Weight



So let's start with something really simple and then we can look at some more interesting examples. This is just a 1m cubed block falling off a wall from a couple meters up. Let's pretend it's a block of concrete. But it's a block that won't fracture. We'll get to that later. [CLICK]

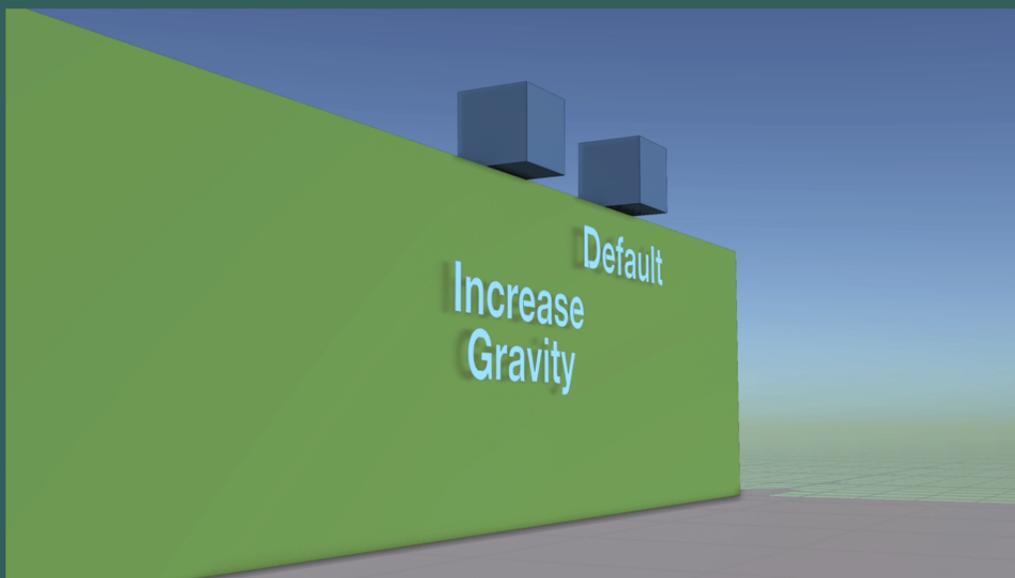
This is about the most boring rbd sim I could possibly make. I'm using default settings for everything. And it shows. It feels floaty. I want to see if I can apply some of the principles to this. I'm going to look at timing and weight as well as exaggeration.



Timing & Weight



The first thing I do is increase the gravity to improve the timing and slow out of the fall. I try to exaggerate this as much as possible while still keeping it believable. If I push it too far I lose the feeling of how big and heavy this object is.

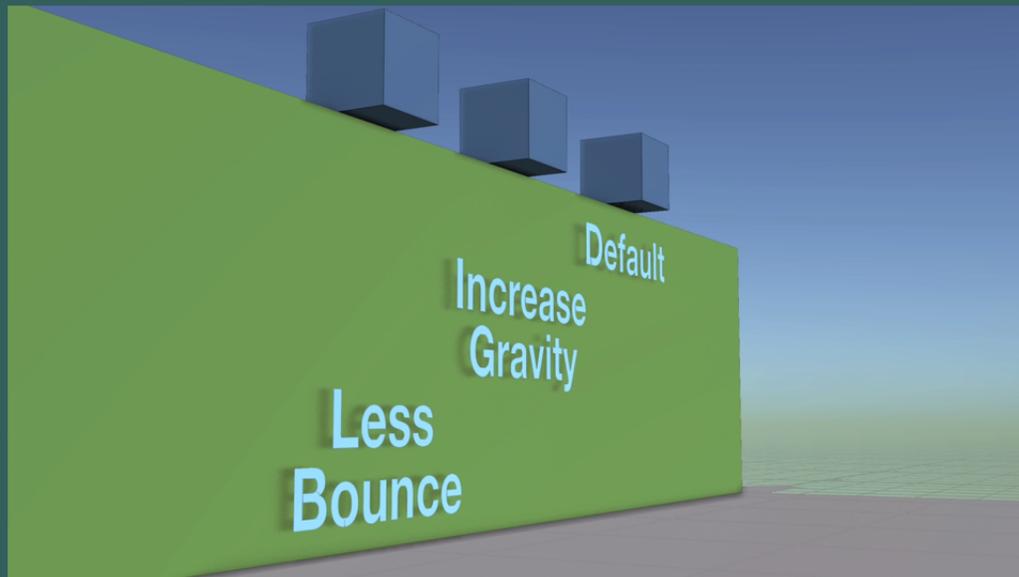


Timing & Weight



Here's that same setup but I've added the lines for every second frame so it's easier to see the difference in the spacing. Kinda like a timing chart for rigid bodies.

So now that I've got a better feel in the fall the added gravity is causing the box to bounce around a lot more. I want to give this concrete block a sense of weight. One of the ways to do that is to create contrast between the movement and the settling. Because the box bounces around so much it feels lighter. So let's fix that.



Timing & Weight



I started dialing in the bounce until I got something which felt good. I'm looking to create a hard-in which is like the opposite of a slow-out. The more contrast I can create between the fall and the land the more impactful the sim feels. So I'm able to take your typical principles and apply them to a rigid body sim.



Contrast



The other thing that I try and look for in terms of contrast is the relationship of one object to another. So how fast is something moving compared to something else because it can tell the story of the weight of something or the importance of it. If everything is moving relatively slowly and one object is moving very quickly that's the thing that your eye is going to be drawn to. That's the thing you're going to focus in on. So I try and keep this idea in mind as a way of staging my scene.

Here the slower chunks feel heavier because there's relationship between them and the faster moving smaller pieces. So size and speed are used to create contrast. There's also some secondary action. Dust and debris from the initial explosion. I prefer to isolate different parts of my simulation into what I consider the main action, secondary action and even a third layer. That way I can exaggerate the relationship and focus on the timing for each one separately.



Anticipation



So what about anticipation? Often rigid body destruction is tied with big explosions but sometimes you can build the tension and let the player know that something is about to happen by anticipating the main action. [CLICK]

Whenever I can, I try add something to call out the destruction. In this case I added some cracks and some falling dust and debris before the arch eventually crumbles. It's subtle but it's enough to create a story around the moment.



Staging & Anticipation



Half the battle with rigid body destruction is just setting the thing up. You've got to fracture it in a nice way, setup the simulation and make sure the sim doesn't blow up unintentionally. Have you got all the pieces of the environment that need to collide with the simulation. And then once the sim is done you need to make sure the remaining debris doesn't interfere with the play space. So sometimes dealing with crafting the animation of the simulation can seem like a lower priority. It's happened to me before. The schedule is really tight and there are other priorities so the very fact that something is being destroyed is considered good enough. But there's no story to the destruction.

Here I've got a simple arch collapsing. All I've done is isolated the pieces that I want to collapse and let the sim run. I think I've shipped a couple of these in the past. But what if we took a bit of time to craft this piece.



Staging & Anticipation



Staging a destruction piece can make it feel so much nicer than just having everything blow-up and fall at the same time. What I've done here is created distinct phases. There's the anticipation as the arch starts cracking and dust starts falling. I then have a couple pieces fall to strengthen that idea. And then I bring it down in stages. So I have a large section fall in and that is enough to cause the rest of it to lose its structural integrity and the whole thing collapses behind it. So now we've got these distinct beats and it really helps, I think, make it a much stronger piece than what I had from the previous example.



Raw



Staged

Before & After



Here's a side by side comparison.



Review

- Observation
- Deconstruct your animation
- Look for ways to add contrast
- Context



So that's how I apply the 12 principles of animation to everything from pulse cannons to fluid simulations.

I find as much reference as possible and be mindful of what I'm looking to pick out depending on the type of reference.

Then I deconstruct my effect to it's simplest form. I like to block out an animation with 4 or 5 frames to describe the whole thing. That forces me to focus on what's important instead of getting stuck in the details. I've shown that you can do that as a starting point, for practice, or as a way to analyse an existing effect.

I want to stay rough so that I can focus on the principles without worrying about the tools or technology.

And then when I apply what I've learned to my effect in the editor I find ways to strengthen the animation either by looking for ways to add contrast or tightening up the application of the principles.

And as soon as I can I get the effect into a level so that I can make sure my decisions make sense in relation to everything else that's going on in the game.



More Resources

- [Pedro Medeiros' Patreon Page](#)
- [Jason Keyser's Youtube Channel](#)
- [BCA FX Online Course – Adam Phillips](#)
- [Realtimevfx.com](#)





VFX for everyone!

- You can grab all the source files from:
http://bit.ly/vfx_animation

twitter:
@mike_lyndon



One of the great things about putting this presentation together was that I got to create everything from scratch. And because I wasn't tied to a project I could cater the effects to the talk. And the really cool thing with that is that I own the rights to pretty much everything I made. So in the spirit of learning I'd like to share with you all of my files. The source files are specific to Houdini and Clip Studio Paint but you could still get some use out of the textures, meshes and uassets in UE4. If you have any questions I'll start up a thread on the realtime vfx forum. So let's keep learning. Let's keep sharing and strengthening this amazing community we have.

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Questions!



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