Kerbalism 3.0 Science Balance Whitepaper

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Please note that on page 3, the figures may be slightly out as I occasionally adjusted experiments. However, I suspect you will get the general gist.

Balance is a large part of gameplay experience. Too easy/ quick means that the game finishes too soon, too hard/long (quiet) and the experience is ruined. Variance is good – over the top repetitively is bad.

The issue that stock science has is that you need to repeat over and over again the experiments. Also, Minmus' scaling factor means that you can complete the Tree without travelling outside the Kerbin SOI. There are a limited number of stock experiments.

Kerbalism 3.0 address some of these concerns. However, the issue of balance is still present in the leadup to release. Minmus is a major sticking point, but I believe I have found a suitable path.

Looking at the stock Tree, as we ascend, new experiments are tiered through. For balance, each experiment should allow for the more expensive nodes of the next tier to be exploited by returning to the same situations and biomes already visited, but also pushing the user forward to explore new territory.

Balance for the game should take into account Minmus, **or** a removal of Minmus. After some thought, Minmus biome hopping should be allowed, my suggestion is to balance this across the beginning of the mid game as Tier 4 is expanded.

The tree too has implied suggestions on appropriate milestones. Crewed Mün landings (Minmus too) should occur once the Mk1 LanderCan has been unlocked (a tier 4 tech cost of 45), the first probe trip beyond Kerbin SOI could occur with the ComMünitron DTS-M1 (a tier 5 tech cost 160).

We should therefore balance the experiment values against the Tree and expected progression, ~~forcing~~ encouraging players to look at inter-planetary exploration, even if un-crewed. Being generous on Normal (100% science) allows for players to play their own style and avoid some of the early grind, like having to visit EVERY biome - Hard (60%) should make life a challenge. Custom 50% may even require Strategies to be used <shudder>, yet this actually enhances gameplay as it gives players choices to use elements of the game that they otherwise wouldn't need.

In saying this, science gains should be balanced to allow for the lack of Contracts and Strategies in a Science Mode game therefore, in a Career Mode with added complexity in costs, the science from contracts and strategies could be considered a bonus. Further science mods simply add ease (reduce grind) with variability.

This paper will make suggestions based on science required to attain the next step.

Assumptions will be:

- No crewed Mün or Minmus landings before the Mk1 Landercan is researched (tier 4), surface samples are available from the start (per Science mode).
- Interplanetary (Eve and Duna) is possible with three/four ComMünitron DTS-M1 (tier 5) on a craft and maxed Tracking Station.
- On 100% total available science for the Kerbin-Mün-Minmus system should max out tier 6, but provide enough to start tier 7.

Also, the role of the lab should allow for, yes its own long term science generation from simply being crewed, but also to transmit data the non-transmittable samples.

theJesuit's Balance suggestions

Stock Tiers	1	2	3	4	5	6	7	8
points per node	5	15,18,20	45	90	160	300	550	1,000
points to unlock each tier	10	53	225	900	2,080	3,600	6,600	5,000
stock cumulative points required	10	63	288	1,188	3,268	6,868	13,468	18,468

So, below is my balance board. You can see that, for the most part, experiments either are 1-3 base points, or 4-6 base points. I'm assuming that you visit the grasslands, shore and water only on Kerbin.

Where the Science Jr, Goo etc. get their real value is by biomes on the ground – keep the unique biome modifier and make the lab required to reset them (i.e scientists can't reset them in the field – needs a 'clean room', or perhaps also use a the mk2 lander?). They don't need large base values as you can use them over and over. These are the biggest exploit in stock where large values + over use = over powered.

Where the Mystery Goo and Science Jr excel, (in stock they have high values right?) is that across all biomes their increased value really racks up. I'm also going to assume that in flight is only a singular biome.

Science Multipliers			Kerbin	Kerbin Orbit	Mün	Mün Orbit	Minmus	Minmus Orbit	Kerbol Orbit	Eve	Eve Orbit	Gilly	Gilly Orbit	Duna	Duna Orbit	Ike	Ike Orbit
high orbit				1.5		2		2.5	1		5		6		5		5
low orbit				1		3		4			7		8		7		7
high atmo			0.9							6				5			
low atmo			0.7							6				5			
splashed			0.4							8		9		8		8	
landed			0.3		4		5			8							
biomes (except Kerbin)			**2**	**11**	**17**		**9**			**15**		**3**		**14**		**8**	
Experiment Name	***availability***	***base points***	Kerbin	Kerbin Orbit	Mün	Mün Orbit	Minmus	Minmus Orbit	Kerbol Orbit	Eve	Eve Orbit	Gilly	Gilly Orbit	Duna	Duna Orbit	Ike	Ike Orbit
LITE (light test)	1	2		5		10		13	2		24		28		24		24
Telemetry	1	2	5.2	5	8	10	10	13	2		24		28		24		24
Geiger Counter	1	6	16	15	24	30	30	39	6		72		84		72		72
Crew report	1	4	10	10	272	20	180	26									
EVA report	1	6	6	15	408	30	270	39									
Mystery Goo	1	10	26	25	680		450										
Thermometer	2	4	10	10	16	20	20	26	4		48		56		48		48
Barometer	2	6	16														
MITE (magnetic test)	2	6		15		30		39	6		72		84		72		72
SITE (dust vacuum test)	3	2		5		10		13	2		24		28		24		24
Sci Jr	3	12	55	30	816	60	540	78									
BEEP (Biome Thing?)	4	4		44		204		144	4		420		96		392		224
Surface Sample	U	10	46		680		450										
Seismic Accelerometer	6	4	2.4		272		180										

At the start, we have crew reports, EVA reports (not in flight) and Goo. Sounding rockets with two landing and a splash down, with lower atmosphere (singular biome?) flight yields 38 points. Which actually takes you up to 42.4 points as you gain the hammer and hit high altitude flight. Completing tier 2 only up to high atmosphere with unlocked Thermometer gives a cumulative total of 52.8, but with the Barometer now available, by the end of tier 2, total cumulative science before orbit is 68.4, or in high and low space around Kerbin 128.4.

So by the end of Tier 2, with the Reliant, the Terrier, decouplers etc. it is possible to orbit the Mün. There is enough science (if all science has been extracted only form high orbit around Kerbin) to unlock the first tier 3 node. Basic Science is unlocked, giving: the Stayputnik with Telemetry, LITE, and MITE, and SITE with Advanced Rocketry. Science Jr. and Geiger Counter are also unlocked. Taking these across the same Kerbin biomes and high and low space around Kerbin reaches 279.4 science, but by this stage crewed Mün orbits should be possible. With Mün orbits, 499.4 science can be accumulated, which will complete all of tier 3, with enough to unlock two tier 4 nodes.

The two tier 4 nodes to unlock would be Electrics for solar panels, along with Advanced Flight Control for the RCS and Mk1 Lander Can. Note, that this is still without a probe Mün surface landing. Every Mün biome with only Telemetry, Geiger Counter and Thermometer will result in 24 science each, which means two transitting only probe landings result in a third tier 4 node to being unlocked.

At this point it is anyone's game with surface samples, Sci Jr and Goo returned from the Mün biomes simply rocketing <ha>the science acquisition on.

If this doesn't seem overly stressing – this is 100% science, Normal Mode, but the nerf of samples plays a big role at Minmus.

The big question here with regards to balance is how often players will want to return to the Mün? There are 17 biomes (according to the wiki). Completing only these experiments along with an unlocked tier 6 Seismic Accelerometer across the whole of the Mün results in 5,544.4 cumulated science, which concludes tiers 4 and 5, (total 3,268) and 8 nodes of the tier 6.

The breaker here is Minmus, as Minmus and its nine biomes with easy hopping takes total cumulation to 9,989.8. This allows for all of tier 6 to be completed, with five tier 7 nodes to be unlocked.

Yet I would argue that this gives good balance. Why? As then to continue on requires players to head out to Duna or Eve, but doing so with any cool unlocked toys they wished – and this is still looking at 100%.

The real balance though is to have the opportunity to remove Minmus, and what that would look like. There is a reason I haven't added in additional science as I wanted to see where we could have gone earlier before the dozen plus crewed Mün landings, and the implications of this.

If Minmus is out of the equation, then flybys, orbits and even a couple of landers on Duna, Ike, Eve and Gilly (I'll refer to these as DIGE) become necessary to stretch out to tier 7. Minmus' advantage is biome hopping with Sci Jr, Goo and Surface Sample returns. Balance should therefore suggest that transmittable science in orbit around DIGE should be comparable to the total science of the Minmus sample returns.

With the tabled suggested values, Minmus (including seismic scans) come to 2560, against the orbital DIGE total of 2258, a difference effectively of a single tier 6 nodes. With several flights required to gain this science either way, I believe this is the balance we are looking for.

With a Hard Mode game, at 60% it will require crews to head beyond Kerbol's SOI, more so on a 50% science game. Note, this balance is also without contract accessed science points, the Negative Gravioli and the various long term crewed science. In the end, users will play how they wish. Not everyone unlocks tier by tier, not everyone used the stock tree. This provides a minimum of fuss, and could be tweaked further still based on other mods being present.

Peace.