

GAME DESIGN DOCUMENT

Jack's Beanstalk Sky Drop



A 6×6 cluster-pays slot with a sticky, multiplier-growing beanstalk garden — math-tuned and Monte-Carlo validated on live game code.

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RTP

96.2%

MAX WIN

5,000×

VOLATILITY

Med-High

GRID

6×6 Cluster

1 Overview

THE PITCH

A Jack-and-the-Beanstalk themed **6×6 cluster-pays** slot built around an original feature: a **sticky garden** of beanstalk wilds that plant, grow, and accumulate **additive multipliers** across the free-spins round. Where most cluster games reset every spin, here the garden *persists* — turning the bonus into a compounding build, not a sequence of independent spins.

96.2%

TOTAL RTP

Validated on real code

5,000×

MAX WIN

Per-round cap

166×

AVG BONUS

Mean payout / round

1 : 245

BONUS TRIGGER

Base spins per trigger

ATTRIBUTE	DETAIL
Title	Jack's Beanstalk Sky Drop
Theme	Jack & the Beanstalk — earth-below / sky-above fairytale
Grid & mechanic	6×6 (36 cells), cluster pays, tumbling/cascading wins
Minimum cluster	5 connected matching symbols
Paying symbols	6 (3 high, 3 low) + 4 specials (bean, water, sun, scatter)
Free spins	8 (sticky garden persists across all 8)
Bonus buy	175× bet (95.0% buy RTP)
Base bet (min)	\$0.20 VERIFY max

2 Key Statistics

VALIDATED FIGURES

METRIC	VALUE	SOURCE / METHOD
Total RTP	96.2%	Monte-Carlo on real game code (96.14% measured)
Base game RTP	28.43%	2M base spins
Bonus mean return	166.3×	200k direct bonus rounds, pooled
Bonus median return	30.4×	Same sample (floor-resaped distribution)
Bonus trigger rate	1 in 245	2M base spins (3+ scatters)
Base hit frequency	51.6%	% of base spins returning a win > 0
Volatility class	Med-High	Median 30× vs mean 166×; cap-hit 0.11%
Max win	5,000×	Enforced cap; hit ~1 in 900 bonuses
≥1,000× bonus reach	3.23%	200k bonus sample
Buy-bonus RTP	95.0%	166.3× mean ÷ 175× cost

VALIDATION METHOD

The headline RTP is not an abstract model estimate. It was measured by a Node harness that imports and runs the **real production game logic** (the same module that serves live spins), pooled across multiple 200k-round samples to suppress trigger-sampling noise, and independently cross-checked against a Python Monte-Carlo sim. Game and sim agree within sampling error.

3 Core Mechanics

BASE GAME

Base spin. A 6×6 grid fills with the 6 paying symbols plus the scatter. Clusters of **5+ connected matching symbols** (orthogonally adjacent) pay. Winning symbols are removed and the board **tumbles** — remaining symbols fall, new ones drop in, and any new clusters pay again — repeating until no new wins form (capped per spin). The base board contains *only* paying symbols and scatters; the special symbols (bean / water / sun) appear exclusively in the bonus.

Scatter. Landing **3 or more scatters** on a spin triggers the bonus. Scatter is a trigger only — it carries no line/cluster pay value.

Paytable (relative pay weighting). Pay scales by cluster size across seven size tiers (5, 6–7, 8–9, 10–12, 13–15, 16+ cells). High symbols pay the curve below; low symbols are scaled fractions of it.

SYMBOL	CLASS	REL. PAY
Golden Goose	High 1	1.00
Harp	High 2	0.80
Gold Coins	High 3	0.62
Red Apple	Low 1	0.30
Green Leaf	Low 2	0.24
Brown Pot	Low 3	0.18
Scatter	Trigger	—

Relative-pay curve confirmed from code; absolute per-tier values flagged for verification.

Symbol drop weights. The board is filled by a weighted random draw. Specials carry zero weight in the base game and positive weight only in the bonus.

SYMBOL	BASE	BONUS
High 1–3	70	70
Low 1	257	257
Low 2	257	257
Low 3	246	246
Water	0	3
Bean	0	3
Sun	0	2
Scatter	0.9	0

Weights from BONUS_W / base weight array [VERIFY](#)

The bonus is **8 free spins** in which a persistent garden of beanstalk wilds is built. Stalks, their heights, and their multipliers **carry across all 8 spins** and clear only at round end — so value compounds as the round progresses.

SPECIAL	TRIGGER	EFFECT
Bean	Lands in a column	Empty column → plants a stalk (height 1); occupied column → grows that stalk +1 (max height 6). Stalks are wild .
Water	Lands anywhere	Grows all existing stalks +1. No-op if no stalks exist.
Sun	Lands anywhere	Rolls once (+1 / +2 / ×2 / ×4) and applies that roll board-wide to every stalk's multiplier.
Scatter	3+ on a spin	Triggers the bonus (entry only — no retrigger in the shipped build).

WILD & MULTIPLIER BEHAVIOUR

Stalks substitute for any paying symbol. When a winning cluster touches one or more stalk columns, those columns' multipliers are summed (**additive**, per distinct column) and applied to the cluster's pay. Sun rolls and water growth feed those per-column multipliers as the garden builds.

Early-garden guarantee. To avoid dead early spins, the first spin guarantees a bean if none drops, and the early spins carry a bean-weight boost — so the garden reliably starts building from spin 1 rather than wasting water on an empty board.

TUMBLE STEP (PER SPIN)	CAPS & LIMITS	VALUE
1 · Drop / refill board	Tumbles / spin	12
2 · Process beans (plant / grow)	Per-stalk multiplier	32× VFY
3 · Process water (grow all)	Per-round win cap	5,000×
4 · Process suns (board-wide roll)	Bonus floor	10×
5 · Detect clusters	Free spins	8
6 · Pay (× summed mult × tier scale)	Stalk max height	6
7 · Remove & tumble (stalks persist)		

BONUS FLOOR — A BUYABLE-BONUS DESIGN CHOICE

Any completed bonus round paying under **10× bet** is lifted to 10×. This guarantees a minimum return so a purchased bonus can never feel worthless — eliminating the dead-buy experience entirely (0% of bonuses pay under 10×) while the round cap and the rare tail keep the top-end excitement intact.

Target RTP **96.2%**, decomposed as base game plus the expected bonus contribution. The governing identity:

```
# Total return decomposition
RTP = base_RTP + ( trigger_prob * bonus_mean )
# 0.2843 + ( 1/245 * 166.3 ) ≈ 0.962
```

Tuning levers, in order of leverage. The dominant driver of the bonus payout shape was **garden depth** — how many stalks plant and how high their multipliers climb within the fixed 8 spins — not the win caps, which the audit showed barely engage (the per-stalk 32× cap is reached by <0.4% of stalks; the 5,000× round cap by ~0.1% of rounds). Bonus value is overwhelmingly multiplier-driven: the additive per-column stalk multipliers, fed by suns and water, account for the great majority of credited pay. The base payable is a minor contributor by comparison.

PROBLEM SOLVED · THE DISTRIBUTION WAS HOLLOW

Early tuning hit the 96.2% target on the *mean* (166×) but with a **median of ~2.9×** — half of all bonuses paid under 3× bet, with the entire return buried in a rare tail. A buyer paying ~100× and receiving single digits most of the time made the bonus feel worthless despite a mathematically correct RTP.

Resolution — reshape, don't re-rate. The fix held RTP constant while moving value out of the ultra-tail and into the body of the distribution: a guaranteed **10× floor** plus a heavily re-weighted tier curve lifting the small/mid clusters. The result — same 96.2% RTP, but the **median rose from 2.9× to 30.4×**, the share of bonuses paying under 10× fell from ~63% to **0%**, funded by trimming the rarest 1,000×+ rounds. Value is conserved; only its shape changed.

2.9× → 30×

MEDIAN LIFT
Same RTP held

63% → 0%

SUB-10× BONOSES
Dead-buy eliminated

95.0%

BUY RTP
Priced off real mean

PROBLEM SOLVED · BUY PRICED FROM THE MATH, NOT CONVENTION

The bonus-buy price is derived as **mean ÷ target RTP**, not a copied "100×" convention. Pricing off the validated 166.3× mean yields a fair value near 173×; the shipped price is a clean **175×** (95.0% buy RTP — deliberately a touch under the headline, the conventional direction for instant-access buys). The price is a single derived constant, and every on-screen "175×" reads from it, so it can never drift from the math.

Measurement discipline. Bonus means are measured by running the bonus function directly over 200k+ rounds (not collected from base-triggered bonuses, which are too few); trigger rate from millions of base spins; totals always pooled across runs to defeat single-run trigger noise. Differences above 0.5pp at large samples were treated as bugs to investigate, never written off as variance — a discipline that surfaced several real sync bugs during development.

Intended experience. The base game is a calm, legible cluster grind; the bonus is the event. The sticky garden gives the free-spins round a *build* arc — each bean and sun visibly raises the ceiling, so the player feels the round compounding rather than watching eight independent spins. Raising the minimum cluster to 5 and concentrating pay into fewer, larger clusters was a deliberate move away from a "constant meaningless small wins" texture toward wins that land with weight.

Volatility feel. Medium-High by design: a fat, reliable body (median 30× bonuses, a guaranteed 10× floor) that makes the feature satisfying to play or buy, sitting under a genuine 5,000× ceiling for top-end pursuit. The reshape consciously traded some jackpot-tail frequency for that dependable body — the right call for a buyable feature, where players engage when they trust the bonus pays.

7 Technology

STACK & ARCHITECTURE

LAYER	CHOICE
Rendering	PixiJS v8
Animation	GSAP
Language / build	TypeScript · Vite
Math sim	Python Monte-Carlo
RTP harness	Node (imports real game logic)
Deploy	Netlify · GitHub CI/CD

Architectural principles.

- **Server-authoritative outcomes** — a mock server decides every result; the client renders, never computes payouts.
- **Single source of truth** — pay values, caps, and the derived buy price live as exported constants; UI strings read from them so display can't drift from math.
- **Sim ↔ game parity** — the sim is the logic reference; the shipping game is tuned and verified against a harness that runs its real code.
- **Data-driven info screen** — the in-game paytable reads live constants, so it can't advertise stale numbers.

! Verify Before Publishing

The figures below were assembled from this project's validated tuning records. Before publishing, confirm each against the current code constants (MockServer.ts / jbsd-sim.py) — the document was authored without direct file access, so these are the values to spot-check rather than trust blind.

Absolute payable values

The relative-pay curve (1.00 / 0.80 / 0.62 high; 0.30 / 0.24 / 0.18 low) and 7 size tiers are confirmed; the absolute per-tier pay numbers were not individually listed — confirm against `PAYTABLE` / `BONUS_TIER_SCALES`.

Symbol drop weights

Bonus weights shown (70/257/257/246/3/3/2, scatter 0) reflect `BONUS_W`; confirm the base-game weight array and the exact scatter base weight (~0.9).

Maximum bet

Min bet \$0.20 confirmed; the maximum bet / full bet ladder was not captured — confirm the bet range.

Per-stalk multiplier cap (32×)

Cited from constants but rarely engaged in play; confirm `STALK_MULT_CAP` = 32.

Sun roll weights

Effects (+1 / +2 / ×2 / ×4) are correct; the individual roll weights (~50/30/15/5) should be confirmed against `SUN_EFFECTS`.

Per-feature RTP split

Base 28.43% and total 96.2% are validated; individual bean/water/sun RTP contributions were not isolated — omit or measure before claiming.

Exact RTP figure

Game measured 96.14%, sim 96.21–96.35%; "96.2%" is the rounded headline. Confirm which figure you want published as the official number.

Stale code comments

During development, several code comments lagged the real constants. Where a comment and a constant disagree, the constant is authoritative.