**URPG — Technical Design Document (TDD) — Comprehensive Build Spec (v2)**

Purpose: This TDD consolidates every finalized decision and workable default discussed so Cursor can start building URPG immediately. It includes platform choices, backend architecture, client state flows, data models, UI contracts, drop logic, construction, cards, objectives/mastery, shop rules, and initial content stubs. Where designs are intentionally left flexible for balancing, the document provides schemas and deterministic algorithms so implementation can proceed without waiting.

# 0. High-Level Goals & Design Pillars

* Long-term casual idle RPG about early space exploration and growth through locations, resources, construction, and cards.
* Three core mechanics: Idle collection, active tapping, and construct-and-wait.
* Progression through multiple leveling paths (player, locations, construction capability, cards, mastery).
* Live-ops friendly: content can be added without breaking saves (new locations, cards, recipes, events).
* Monetization: Free-to-play with optional purchases to accelerate progress; shop system rotates items every 3 hours.
* Developer Tool (admin-only) to safely tune content: edit drop tables, recipes, and odds without redeploy.

# 1. Platform & Tech Stack

## Frontend

* Web (desktop first, mobile web friendly): React + TypeScript.
* State: Redux Toolkit (RTK) + RTK Query for server data. React context permitted for lightweight UI-only state.
* Rendering: Canvas/SVG as needed for map and simple animations (planet rotation), but keep V1 minimal.
* Build: Vite or Next.js (pages/app) — choose Vite for pure SPA simplicity for MVP.

## Backend (MVP)

* Firebase: Auth (email/password), Firestore (realtime DB), Cloud Functions (server logic), Cloud Storage (assets), Cloud Scheduler (cron).
* Reason: fastest path, scalable, built-in security rules, easy client integration.

## Sessions & Saves

* Online only: client requires connection; autosave continuously to Firestore.
* Single active session per account enforced by server-issued session token (custom claim).
* Conflict policy: newer server-timestamped writes win; client performs merge for purely additive lists.

## Accounts & Auth

* MVP: one account per email; email + password signup with optional email verification (stay signed in).
* Recovery: email-based reset. Future: Sign-in with Apple/Google when ported to native.

## Time & RNG

* Server time is authoritative (Cloud Functions + Firestore serverTimestamp).
* RNG: seedable per-user per-location for reproducible drop tests; cryptographically secure not required, but use server-side draw for important rolls.

# 2. Game Loops & Rules

## 2.1 Core Loops

* Minute-to-minute: check constructions, start new build, tap current location, manage resources, quick shop buy/sell.
* Hourly/Daily: collect builds, adjust slotted items/cards, fulfill dailies, check rotating shop, monitor storage.
* Long-term: unlock locations, craft advanced tech, expand bays, collect/upgrade cards, complete masteries.

## 2.2 Idle & Active Collection

* Each location produces items passively at a base rate: 1 item/min (configurable).
* Click/tap produces 1 item per tap; tapping applies a rarity bias multiplier (configurable per location, default 1.0).
* When offline, accrual is capped at 1 hour (base). Cards/mastery/items may extend later. Constructions continue to completion regardless of cap.

## 2.3 Storage & Capacity

* All collected and crafted items live in Resources. Cards have their own screen. Currency shown on top bar and mirrored as a resource row.
* Storage caps exist per-resource and are upgradeable; MVP defaults: 1,000 per basic resource (tunable).

# 3. UI/UX Contract (MVP)

## 3.1 Global Layout

* Top Bar (always visible): Left—Settings; Center—Player Name, Level bar, Objectives/Mastery arrow; Right—Currency total.
* Comms button on bottom left side of screen, above Bottom Nav, Overlaying any gameplay.
* Bottom Nav (always visible; left→right): 1 Shop, 2 Construction, 3 Star Map, 4 Resources, 5 Cards.
* Detailed Views: slide-in/appear panel below top bar (top quarter of screen). Never covers top or bottom bars; closable with X; stays open while underlying content scrolls; switches instantly when selecting another item.
* Bottom Action Slots: 4 per screen (Location, Construction, Star Map, Resources, Cards). Slots are unique per screen.

## 3.2 Style

* Visual vibe: spaceship bridge console; black backgrounds; flat/minimal for MVP; later skeuomorphic pass.
* Motion: subtle glows; no fades; no zoom; planet rotation is high-priority visual effect.

## 3.3 Screen Specs

### Shop

* Grid 2×3 (6 items), refresh every 3 hours. item\_1 is always free. Each shows icon, name, price (with 10% tariff on sellback), stock in bottom-right.
* Future: multiple shopkeepers unlocked by progress.

### Construction

* Scrollable list of bays: Small, Medium, Large (visually same size rows). Start with 1 Small unlocked; more unlockable.
* Row shows: icon, recipe name (or Empty), remaining time (mm for ≥10m; mm:ss for <10m).
* Selecting a bay opens its Detailed View: recipe dropdown (favorites pinned top, alphabetical; unavailable greyed and pushed bottom). Ingredient slots are informational (auto-filled).
* Cancellation: full material refund; currency cost is lost.
* No build queue in MVP (one active job per bay).

### Star Map

* Hierarchy: Location → System → Constellation (V1). Telescope button moves out one level. Icons: yellow/white (zoom deeper), green/blue/purple/red (enter location).
* Locations rotate naturally.

### Resources

* Primary view: 5-across grid; count shown bottom-right (capped at 99+). Selecting opens Detailed View with exact count and metadata.
* Sorting filters planned (A–Z, rarity, amount asc/desc, type); MVP ships with A–Z.

### Cards

* Shows owned cards as beveled rectangles with minimal/iconic art. Subpanel identical behavior to Resources.
* Card classes: Explorer, Constructor, Collector, Progression. 8 cards each (total 32 for MVP).

### Objectives/Mastery (Top Bar ↓)

* Opens a full screen below top bar; tabs: Daily, Seasonal, Permanent, Mastery.
* Entries are 1–2 lines with progress bar and numeric overlay. Claim button appears when complete; arrow glows when claims pending.
* Rewards: XP always + optional items/cards/currency/recipes/locations (content TBD). Mastery claim resets tier to next.

# 4. Mechanics

## 4.1 Drop Tables & Odds

* Each location has 10 items with fixed odds: [30%, 20%, 15%, 10%, 8%, 6%, 5%, 3%, 2%, 1%].
* Idle draw: 1 item/min, weighted by odds. Tap draw: 1 item/tap with rarity bias multiplier (default 1.1 applied to lower odds buckets).
* No item repeats across the 11 defined locations for MVP content set (enforced by content generator or dev tool).
* Stars (Taragon Gamma, Taragon Beta, Violis Alpha) — V1 constraint: element/plasma/isotope-only drops.

## 4.2 Cards

* Collection sources: objectives, passive location drops, tapping, and as rare construction rewards.
* Fusion (upgrade) tiers by copies: 2 → 5 → 10 → 25 → 100 (levels 1–5). Effects strengthen per tier.
* Slots: Each of the 5 screens has its own 4 slots. A card slotted on a screen applies only to that screen and is ‘in use’ (greyed in Cards). Items can also be slotted; items expire (glow ring burns down).

## 4.3 Construction

* Bays: Small/Medium/Large. One job active per bay. Unlock additional bays via progression.
* Recipe selection via dropdown; unavailable recipes greyed & listed last; favorites pin to top.
* On cancel: refund all input materials; lose any currency cost.

## 4.4 Objectives & Mastery

* Tabs: Daily / Seasonal / Permanent / Mastery. Compact rows with progress bar + numbers. Clicking entries does not open deeper details in MVP.
* Claim buttons grant rewards and clear/advance the entry; top arrow glows when claims exist.
* Mastery tracks: taps, locations discovered, items constructed, recipes unlocked, bays unlocked, items used, resources collected/sold, currency earned, cards collected/upgraded (list expandable).

## 4.5 Shop & Economy

* Sellback: fixed price with 10% tariff.
* Shop refresh: every 3 hours server-side. 6 items, with item\_1 always free.
* Currency: shown on Top Bar; also mirrored as a Resource entry for completeness.

## 4.6 Progression & Levels

* Player Level increases with XP from actions, objectives, and mastery claims; thresholds escalate per level (non-linear).
* Location levels, bay unlocks, and card power are parallel progress vectors; player level may gate features/locations.

## 4.7 Offline Accrual

* Base cap: 1 hour of passive gains. Constructions continue to finish. Future: cap extensions via cards/mastery/items.

# 5. Data Model (Firestore + Client Types)

## Collections Overview

* users/{uid}: profile, session, currencies, top-level progress pointers
* inventories/{uid}: per-resource quantities
* locations/{locId}: static content; user\_locations/{uid}/{locId}: player-specific state
* cards/{cardId}: static; user\_cards/{uid}/{cardId}: counts, tiers, slotted state per screen
* recipes/{recipeId}: static; user\_recipes/{uid}/{recipeId}: unlocked flags, favorites
* bays/{uid}/{bayId}: type, active job, finishAt
* drop\_tables/{locId}: ten entries with resourceId and weight
* shops/current: 6 items + refreshAt
* objectives/{type}/{id}: definitions; user\_objectives/{uid}/{id}: progress, claimed flags
* mastery\_defs/{id}: thresholds; user\_mastery/{uid}/{id}: progress, tier

## TypeScript Interfaces (abridged)

type ScreenId = 'SHOP'|'CONSTRUCTION'|'MAP'|'RESOURCES'|'CARDS';  
  
interface User {  
 uid: string;  
 email: string;  
 displayName: string;  
 level: number;  
 xp: number;  
 currency: number;  
 createdAt: number; // serverTimestamp  
 lastActiveAt: number; // for offline accrual  
 roles?: string[]; // 'dev'  
}  
  
interface Resource {  
 id: string;  
 name: string;  
 tags: string[]; // e.g., ['Element','Gas','Organic','Tech l3']  
 unit: string; // 'km3','m3','ton','group','unit'  
 rarity?: 'common'|'uncommon'|'rare'|'epic'|'legendary';  
 desc?: string;  
}  
  
interface UserInventory {  
 [resourceId: string]: number; // quantity  
}  
  
interface LocationDef {  
 id: string;  
 name: string;  
 kind: 'planet'|'moon'|'star'|'anomaly'|'ship'|'dwarf'|'rogue';  
 system: string; // Taragon Gamma, etc.  
 constellation?: string;// Violis  
 visuals: { palette: string[]; rotates: boolean };  
 rules: { baseRatePerMin: number; tapBias: number; };  
}  
  
interface DropEntry { resourceId: string; weight: number; } // weights reflect target odds  
interface DropTable { locationId: string; entries: DropEntry[]; } // len=10  
  
interface Bay {  
 id: string;  
 size: 'S'|'M'|'L';  
 unlocked: boolean;  
 activeJob?: Job;  
}  
  
interface Job {  
 recipeId: string;  
 startedAt: number;  
 finishesAt: number;  
 currencyCost: number;  
 inputs: { resourceId: string; qty: number; }[];  
 outputs: { resourceId: string; qty: number; }[];  
}  
  
interface Recipe {  
 id: string;  
 name: string;  
 timeSec: number;  
 inputs: { resourceId: string; qty: number; }[];  
 outputs: { resourceId: string; qty: number; }[];  
 size: 'S'|'M'|'L';  
}  
  
type CardClass = 'Explorer'|'Constructor'|'Collector'|'Progression';  
  
interface CardDef {  
 id: string;  
 name: string;  
 cls: CardClass;  
 effectKey: string; // e.g., 'tapYieldMultiplier'  
 tiers: { copies: number; value: number; }[]; // copies required and effect value per tier  
}  
  
interface UserCard {  
 cardId: string;  
 copies: number;  
 tier: number; // 1..5  
 slottedOn?: ScreenId[]; // which screens currently using this card  
}  
  
interface ObjectiveDef {  
 id: string;  
 type: 'daily'|'seasonal'|'permanent';  
 text: string;  
 target: number;  
 trackKey: string; // e.g., 'taps','builds','collect\_resource:water'  
 rewards: { xp: number; currency?: number; cardId?: string; resourcePack?: {resourceId:string, qty:number}[] }[];  
}  
  
interface UserObjective {  
 id: string;  
 progress: number;  
 completed: boolean;  
 claimed: boolean;  
}  
  
interface MasteryDef {  
 id: string;  
 name: string;  
 thresholds: number[]; // e.g., [100, 500, 2000, 10000, ...]  
}  
  
interface UserMastery {  
 id: string;  
 count: number;  
 tier: number; // current achieved tier index  
}

# 6. Algorithms & Server Logic

## 6.1 Weighted Drops

Let W = [30,20,15,10,8,6,5,3,2,1] (sum 100). For idle: draw once per minute using server RNG; award item if storage cap allows.   
For tapping: apply tapBias to lower buckets (e.g., multiply weights for ranks 8–10 by 1.1, normalize). TapBias is per-location configurable (default 1.0 = same odds).

## 6.2 Offline Accrual

On login/resume, compute elapsed = min(now - lastActiveAt, 3600s \* offlineCapHours). Award floor(elapsed/60) idle draws through the same drop routine,   
respecting storage caps. Update lastActiveAt server-side. Constructions finish if finishesAt <= now.

## 6.3 Construction

StartJob(uid,bayId,recipeId): validate bay unlocked & idle, user has inputs & currency; deduct materials & currency; set finishesAt=now+timeSec; write Job.  
CancelJob: return inputs, do NOT return currency; clear job.  
CompleteJob (cron/watch): on finishesAt, credit outputs; mark bay idle.

## 6.4 Cards & Fusion

GainCard(uid,cardId): increment copies; while copies>=req for next tier, auto-upgrade tier and reduce copies by req.   
SlotCard(uid,cardId,screen): ensure not already slotted elsewhere if exclusivity required; mark slottedOn includes screen.

## 6.5 Objectives & Mastery

Trackers increment server-side on relevant events (tap, craft, collect, sell, discover). When progress>=target, set completed=true and light the top-arrow.   
Claim grants rewards and sets claimed=true; for Mastery, increment tier and set next threshold as target.

## 6.6 Shop Rotation

Every 3 hours (Cloud Scheduler), generate 6 offers: item\_1 is free (sample from low-rarity pool), items\_2..6 priced. Each offer has limited stock.   
Sellback applies 10% tariff. Persist to shops/current with refreshAt.

# 7. Content — Locations (V1)

Map hierarchy: Location → System → Constellation. Higher tiers (Quadrant, Galaxy, etc.) are out of scope for V1 but reserved in data model.

## Defined Systems & Constellation

* System #1: Taragon Gamma (class 3 star, main sequence, yellow) — 5 locations
* System #2: Taragon Beta (class 5 star, main sequence, deep red) — 3 locations
* Constellation: Violis — 3 locations

## All 11 Locations

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| # | Location | Type | Parent | Notes |
| 1 | TaraGam 7 | planet (habitable) | Taragon Gamma | Blues/greens/white caps; city lights on dark side |
| 2 | Elcinto | moon | Taragon Gamma | Brown/yellow hues |
| 3 | TaraGam 3 | ice planet (ringed) | Taragon Gamma | Whites and blues |
| 4 | Abandoned Star Ship | derelict ship | Taragon Gamma | Interactive lore later |
| 5 | Taragon Gamma | star (class 3) | Taragon Gamma | Element-only drops |
| 6 | Ernest’s Homestead | moon | Taragon Beta | Harsh landscape; shallow broken oceans; polar caps |
| 7 | TaraBet 10 | brown dwarf (supermassive planet) | Taragon Beta | Browns/reds/yellows |
| 8 | Taragon Beta | star (class 5) | Taragon Beta | Element-only drops |
| 9 | Violis Alpha | dwarf star (class 2) | Violis | Element-only drops; deep purple |
| 10 | Rouge Planet | rogue ice planet | Violis | Light blue |
| 11 | Quantum Anomaly | gas cloud | Violis | Shifting colors |

## Drop Tables — Contract

Every location defines 10 resources with weights mapping to the fixed odds. For MVP the data can be generated deterministically and modified in the Dev Tool.

IMPORTANT: Stars (5, 8, 9) use element/isotope/plasma-only resources in V1. Non-star locations may include compounds, organics, and tech items.

Cursor Action: Implement the schema below and load initial stubs; designer may adjust live via Dev Tool.

### DropTable JSON (example)

{  
 "locationId":"taragam-7",  
 "entries":[  
 {"resourceId":"water","weight":30},  
 {"resourceId":"oxygen-tank","weight":20},  
 {"resourceId":"carbon-graphite","weight":15},  
 {"resourceId":"iron","weight":10},  
 {"resourceId":"silicon","weight":8},  
 {"resourceId":"glass-tubes","weight":6},  
 {"resourceId":"microchip","weight":5},  
 {"resourceId":"gold","weight":3},  
 {"resourceId":"diamond","weight":2},  
 {"resourceId":"fusion-reactor","weight":1}  
 ]  
}

# 8. Content — Resource Catalog (Complete)

All items are present in code; availability is controlled by drop tables and recipes. Units are noted per category.

## 8.1 Elements — Gases (km³)

* Hydrogen tank [tags: Element, Gas, unit: km³]
* Oxygen tank (O2) [tags: Element, Gas, unit: km³]
* Nitrogen tank (N2) [tags: Element, Gas, unit: km³]

## Elements — Gases (m³)

* Helium tank [tags: Element, Gas, unit: m³]
* Lithium tank [tags: Element, Gas, unit: m³]
* Neon tank [tags: Element, Gas, unit: m³]

## Elements — Liquids (m³)

* Mercury [tags: Element, Liquid, unit: m³]

## Elements — Solids (m³)

* Graphite [tags: Element, Solid, unit: m³]
* Diamond [tags: Element, Solid, unit: m³]
* Sodium [tags: Element, Solid, unit: m³]
* Silicon [tags: Element, Solid, unit: m³]
* Sulphur [tags: Element, Solid, unit: m³]
* Titanium [tags: Element, Solid, unit: m³]
* Iron [tags: Element, Solid, unit: m³]
* Nickle [tags: Element, Solid, unit: m³]
* Copper [tags: Element, Solid, unit: m³]
* Zinc [tags: Element, Solid, unit: m³]
* Silver [tags: Element, Solid, unit: m³]
* Gold [tags: Element, Solid, unit: m³]
* Lead [tags: Element, Solid, unit: m³]
* Radium [tags: Element, Solid, unit: m³]
* Uranium [tags: Element, Solid, unit: m³]
* Plutonium [tags: Element, Solid, unit: m³]

## 8.2 Inorganic Compounds

### Gases (km³)

* CO2 [tags: Inorganic, Gas, unit: km³]
* Ammonia [tags: Inorganic, Gas, unit: km³]
* Ozone [tags: Inorganic, Gas, unit: km³]

### Liquids (km³)

* Water [tags: Inorganic, Liquid, unit: km³]
* Bromine [tags: Inorganic, Liquid, unit: km³]
* Sulfuric Acid [tags: Inorganic, Liquid, unit: km³]
* Nitric Acid [tags: Inorganic, Liquid, unit: km³]

### Solids (km³)

* Quartz [tags: Inorganic, Solid, unit: km³]

### Solids (tons)

* Salt [tags: Inorganic, Solid, unit: ton]

## 8.3 Organics & Living

### Organic Compounds (m³)

* Methane [tags: Organic, Compound, unit: m³]
* Ethanol [tags: Organic, Compound, unit: m³]
* Glycerol [tags: Organic, Compound, unit: m³]
* Glucose [tags: Organic, Compound, unit: m³]
* Citric Acid [tags: Organic, Compound, unit: m³]

### Organic Items (tons)

* Dirt/soil (containers) [tags: Organic, Item, unit: ton]
* Oil (vats) [tags: Organic, Item, unit: ton]
* Natural Gas (tanks) [tags: Organic, Item, unit: ton]
* Lumber (beams) [tags: Organic, Item, unit: ton]
* Charcoal [tags: Organic, Item, unit: ton]
* Fruit Seeds [tags: Organic, Item, unit: ton]
* Vegetable Seeds [tags: Organic, Item, unit: ton]
* Cordyceps (Mushrooms) [tags: Organic, Item, unit: ton]
* Sea Meat [tags: Organic, Item, unit: ton]
* Land Meat [tags: Organic, Item, unit: ton]

### Living Items (groups)

* Genetically Modified Mammals [tags: Living, Breeding, unit: group]

## 8.4 Man‑Made — Primitive l1

* Steel (in Pylons) [tags: Tech l1, Primitive]
* Glass (tubes) [tags: Tech l1, Primitive]
* Rubber (sheets) [tags: Tech l1, Primitive]
* Plastic (sheets) [tags: Tech l1, Primitive]
* Cloth (spools) [tags: Tech l1, Primitive]
* Lighter [tags: Tech l1, Primitive]
* Adhesive [tags: Tech l1, Primitive]
* Water Filter [tags: Tech l1, Primitive]
* Sail [tags: Tech l1, Primitive]
* Wind Turbine [tags: Tech l1, Primitive]
* Pully & Lever [tags: Tech l1, Primitive]

## Man‑Made — Primitive l2

* Gyroscope [tags: Tech l1, Primitive l2]
* Telescope [tags: Tech l1, Primitive l2]
* Lightbulb [tags: Tech l1, Primitive l2]
* Radio [tags: Tech l1, Primitive l2]

## Man‑Made — Primitive l3

* Microwave [tags: Tech l1, Primitive l3]
* Refrigerator [tags: Tech l1, Primitive l3]
* Combustion Engine [tags: Tech l1, Primitive l3]
* Calculator [tags: Tech l1, Primitive l3]
* Camera [tags: Tech l1, Primitive l3]
* Video Recorder [tags: Tech l1, Primitive l3]
* Scanner [tags: Tech l1, Primitive l3]
* Printer [tags: Tech l1, Primitive l3]
* LED [tags: Tech l1, Primitive l3]

## 8.5 Technological l1

* Capacitor [tags: Tech l1]
* Microchip [tags: Tech l1]
* Superconductor [tags: Tech l1]
* Electromagnet [tags: Tech l1]
* Lithium-Ion Battery [tags: Tech l1]
* Laser [tags: Tech l1]
* CPU [tags: Tech l1]
* GPU [tags: Tech l1]
* Xray Scanner [tags: Tech l1]
* Body Scanner [tags: Tech l1]
* Satellite dish [tags: Tech l1]
* Orbital satellite [tags: Tech l1]

## Technological l2

* Rockets [tags: Tech l2]
* Space Station [tags: Tech l2]
* Supercollider [tags: Tech l2]
* Solar Panels [tags: Tech l2]
* 3D Printer [tags: Tech l2]
* Hydrogen Fuel Cell [tags: Tech l2]
* LoFi AI Chips [tags: Tech l2]
* Quantum Chips [tags: Tech l2]

## Medical l1

* Antibiotics [tags: Medical l1]
* Antivirals [tags: Medical l1]
* Antihistamines [tags: Medical l1]
* Stimulants [tags: Medical l1]
* General Anesthesia [tags: Medical l1]

## Medical l2

* Surgical Bots [tags: Medical l2]
* Regrowth Serum [tags: Medical l2]
* GeneHack Treatment [tags: Medical l2]

## Technological l3

* NanoBot Hive [tags: Tech l3]
* Elemental Harvesters [tags: Tech l3]
* Solar Sails [tags: Tech l3]
* VR Implant Chip [tags: Tech l3]
* Singularities [tags: Tech l3]
* Memory [tags: Tech l3]
* Fusion Reactor [tags: Tech l3]

## Medical l3

* Nano Menders [tags: Medical l3]
* Cryo Chambers [tags: Medical l3]
* Antitelemrics (tumor/cancer killers) [tags: Medical l3]
* De-Aging Pills [tags: Medical l3]

## Technological l4

* GravNav (gravity manipulator – hover technology) [tags: Tech l4]
* FTL drive [tags: Tech l4]
* brAInchip [tags: Tech l4]
* Light Tracker (for photonic tracking, especially of FTL ships) [tags: Tech l4]
* Dilation Meter [tags: Tech l4]
* Quantum State Energy Reactor [tags: Tech l4]

## Technological l5

* Repel Field Generator (force field) [tags: Tech l5]
* Mindbreaker (mind controller) [tags: Tech l5]
* Integrated NueoMatrix (mind cloud backup) [tags: Tech l5]
* State Regulator (Matter state alteration field) [tags: Tech l5]
* PlankFlux Reactor [tags: Tech l5]

## Technological l6

* Light Bender [tags: Tech l6]
* Teleportation Framework [tags: Tech l6]
* Telekinetic Suit [tags: Tech l6]
* ZeroState Computer [tags: Tech l6]
* Probability Lenses [tags: Tech l6]

## 8.6 Star-Harvestable Specials (Added Catalog)

These 20 items were added for star-related content. Items 1–10 are element/isotope/plasma-like. Items 11–20 are advanced tech components derived from stellar phenomena (reserved for non-star drops in V1).

### Elemental/Plasma (1–10)

* Helium‑3 Canister [tags: Element, Stellar, unit: m³/km³ as applicable]
* Deuterium Gas (D2) [tags: Element, Stellar, unit: m³/km³ as applicable]
* Tritium Trace (T2) [tags: Element, Stellar, unit: m³/km³ as applicable]
* Ionized Hydrogen Plasma [tags: Element, Stellar, unit: m³/km³ as applicable]
* Solar Wind Isotope Mix [tags: Element, Stellar, unit: m³/km³ as applicable]
* Neutrino Telemetry Packet [tags: Element, Stellar, unit: m³/km³ as applicable]
* Coronal Ejecta Dust [tags: Element, Stellar, unit: m³/km³ as applicable]
* Stellar Nanodiamond Particulates [tags: Element, Stellar, unit: m³/km³ as applicable]
* Sunspot Spectral Sample [tags: Element, Stellar, unit: m³/km³ as applicable]
* Magnetic Flux Filament [tags: Element, Stellar, unit: m³/km³ as applicable]

### Advanced Tech (11–20)

* Photonic Heat Shield Film (panel) [tags: Tech (l2–l6), Stellar-derived]
* Plasma Containment Lattice [tags: Tech (l2–l6), Stellar-derived]
* Stellar Interferometer Array Chip [tags: Tech (l2–l6), Stellar-derived]
* Helioseismic Analyzer Module [tags: Tech (l2–l6), Stellar-derived]
* Neutrino Spectrometer Core [tags: Tech (l2–l6), Stellar-derived]
* Magnetohydrodynamic Coil [tags: Tech (l2–l6), Stellar-derived]
* Radiative Shielding Tiles [tags: Tech (l2–l6), Stellar-derived]
* Flux‑Pinning Superconductor Matrix [tags: Tech (l2–l6), Stellar-derived]
* Antimatter Containment Vial [tags: Tech (l2–l6), Stellar-derived]
* Quantum Solar Sail Weave [tags: Tech (l2–l6), Stellar-derived]

# 9. Cards (32 total for MVP)

Four classes with 8 cards each. Effects are representative; exact values can be tuned. Fusion uses copies [2,5,10,25,100].

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Class | Card | Effect Key | Tier Values (example) | Notes |
| Explorer | Astro Prospector | tapYieldMultiplier | [+2%, +4%, +7%, +11%, +16%] | Applies on Resources/Map screens when slotted |
| Explorer | Deep Scan | idleRareBias | [+3%, +6%, +10%, +15%, +22%] | Bias lower-prob slots upward |
| Constructor | Bay Optimizer | buildTimeMultiplier | [-2%, -4%, -7%, -11%, -16%] | Faster builds on Construction screen |
| Collector | Bulk Storage | storageCapBonus | +100,+250,+500,+900,+1500 | Increases per-resource caps |
| Progression | Learned Hands | xpGainMultiplier | [+2%, +4%, +6%, +9%, +13%] | Global XP boost when slotted on any screen |

…Define remaining 27 cards similarly using the CardDef schema; ensure each class totals 8 cards.

# 10. Developer Tool (Admin)

* Access: gated by Firebase custom claim 'dev'. UI access point TBD (hidden).
* MVP scope: edit drop tables (pick 10 items & weights), edit recipes (inputs/outputs/time), toggle unlock flags, set shop lineup, grant test currency.
* Dangerous ops (grant items/cards/levels) moved to separate Admin panel, disabled in production by rules.
* All dev actions logged with user/time and a revert snapshot.

# 11. Security & Rules

* Firestore security rules to restrict writes to own uid; server validates sensitive ops (craft, claim, shop buy/sell).
* Anti-cheat basic: server-side time source; no client-set timers; rate-limit taps; sanity caps on accrual and purchases.
* PII minimal; store email only.

# 12. Build Plan (Milestones)

* M0: Project setup + Auth + data scaffolding + basic top/bottom bars + navigation (1–2 weeks).
* M1: Resources (grid + detailed view + inventory data) + idle accrual loop + star map shell (2 weeks).
* M2: Construction (bays, recipes, timers, cancel/refund) + bottom slots framework (2–3 weeks).
* M3: Cards (collection, fusion, slotted behavior per screen) + basic effects wiring (2 weeks).
* M4: Objectives/Mastery UI + trackers + claim flow (2 weeks).
* M5: Shop rotation + buy/sell/tariff + polish + Dev Tool v1 (2 weeks).

# 13. JSON Seeds (Examples)

## 13.1 Location Seeds (3 examples)

taragam-7:  
 kind: 'planet'  
 system: 'Taragon Gamma'  
 rules: { baseRatePerMin: 1, tapBias: 1.1 }  
elcinto:  
 kind: 'moon'  
 system: 'Taragon Gamma'  
 rules: { baseRatePerMin: 1, tapBias: 1.1 }  
taragon-gamma:  
 kind: 'star'  
 system: 'Taragon Gamma'  
 rules: { baseRatePerMin: 1, tapBias: 1.1 }

## 13.2 DropTable Seeds (illustrative only)

taragon-gamma (star) entries: [Helium‑3 Canister, Deuterium Gas, Ionized Hydrogen Plasma, Solar Wind Isotope Mix, Neutrino Telemetry Packet,  
Coronal Ejecta Dust, Stellar Nanodiamond Particulates, Sunspot Spectral Sample, Magnetic Flux Filament, Tritium Trace] with weights [30..1].

Non-star locations follow the same pattern using unique items drawn from the catalog; enforce uniqueness across the 11 locations in MVP.

# 14. Open Items & Defaults Applied

* Rewards tuning for objectives/mastery: deferred; UI/trackers implemented now.
* Micro-interactions list per button: deferred; structure supports adding easily.
* Card full roster and numbers: 5 examples provided; fill out remaining per schema during content pass.
* Exact art/palette/fonts: minimal defaults; future skeuomorphic pass.
* Wireframes are being authored in Figma by designer; this TDD defines contracts expected by engineering.

# 15. Appendix — Deterministic Content Assignment

To avoid blocking on manual curation while honoring constraints, implement a content generator that:  
1) Shuffles the full resource catalog with a fixed seed per-environment.  
2) For each location in order, picks the next 10 items that satisfy constraints (for stars: only star-eligible elements/isotopes/plasma), ensuring no repeats.  
3) Writes drop\_tables/{locId}.entries with weight ladder [30,20,15,10,8,6,5,3,2,1].  
The Dev Tool can then adjust entries/weights live without redeploy.