6th Grade DESIGN CHALLENGE

Arcade Entrepreneur

Teacher Facilitation Guide

Duration: ~11 45–50 minute class sessions

CHALLENGE OVERVIEW

Pat “Pac” Manning is back. After the team’s work on data and the catapult-prize game, Pat wants something brand-new for Pixel Palace: an original arcade game that customers have never seen before. Pat sends the class a Request for Proposals (RFP) inviting design teams to pitch a new game — but with rules. The game has to be fun, fair, safe, buildable, and profitable.

Working in teams of three, students take a game from idea to prototype using the full engineering design process. They choose a game type from Pat’s menu (or pitch their own), research how similar games work, sketch and evaluate competing concepts, and design one custom game part in TinkerCAD. Teams then build a working prototype from cardstock and craft materials, test it to collect win-rate and profit data, iterate on their design, and deliver a final pitch to Pat.

This Design Challenge is the third unit in the 6th-grade Pixel Palace sequence (Data Challenge → Systems Challenge → Design Challenge). It reconnects students with Pat and the arcade context and brings back the probability and profit reasoning from earlier units, but it does not require that students completed those units first.

MODULE STRUCTURE

Activity 1 — Pat’s RFP & the Design Challenge (Day 1)
Activity 2 — How Arcade Games Work: Market Research (Day 2)
Activity 3 — TinkerCAD On-Ramp: Intro to 3D Modeling (Day 3)
Activity 4 — Modeling Your Custom Part in TinkerCAD (Day 4)
Activity 5 — Ideation & Concept Sketching (Day 5)
Activity 6 — Concept Evaluation & Selection (Day 6)
Activity 7 — Build the Prototype (Days 7–8)
Activity 8 — Playtest & Collect Data (Day 9)
Activity 9 — Iterate & Improve (Day 10)
Activity 10 — Pitch Prep, Final Pitches & Reflection (Day 11)

MATERIALS
Cardstock (assorted colors) — main prototyping material
Craft materials: craft sticks, pipe cleaners, straws, rubber bands, paper cups, pompoms, marbles or ping-pong balls
Tape (masking + clear), glue sticks, binder clips
Scissors; a few craft knives (teacher-supervised)
Rulers and measuring tape
Cardboard sheets / box flaps for bases and ramps
Computers or Chromebooks with internet for TinkerCAD (free class account)
Optional: 3D printer for printing custom parts (not required — see Teacher Tip)
Pat’s RFP, Game Menu, Design Notebook, Evaluation Matrix, Playtest Data Sheet, Pitch Planner, Rubric Handout 1 – Pixel Palace Request for Proposal Handout 2 – Pixel Palace Game Menu Handout 3 – TinkerCAD Quick Start Guide Handout 4 – Custom Part Planner Handout 5 – Concept Evaluation Matrix Handout 6 – Test Data Sheet Handout 7 – Pitch Planner Handout 8 – Design Challenge Rubric

KEY VOCABULARY

RFP (Request for Proposals): a document a client sends to invite design teams to propose solutions and to spell out the requirements.

Criteria: the things a successful design must do (fun, fair, safe, profitable).

Constraints: the limits a design must stay within (materials, size, budget, time).

Prototype: an early working version of a design, built to test ideas.

Iteration: improving a design by testing it, learning from the results, and making changes.

CAD (Computer-Aided Design): using software such as TinkerCAD to build a 3D model of a part.

Custom part: a piece students design themselves rather than using an off-the-shelf object.

Probability / odds: the chance an event happens, used here to set how often players win.

Expected profit: the average money the arcade makes (or loses) per play, over many plays.

Decision matrix: a tool for scoring competing design concepts against the criteria.

STANDARDS ALIGNMENT

NGSS Engineering Design

MS-ETS1-1: Define the criteria and constraints of a design problem
MS-ETS1-2: Evaluate competing design solutions using a systematic process
MS-ETS1-3: Analyze data from tests to identify the best characteristics of each solution
MS-ETS1-4: Develop a model to generate data for iterative testing and modification

Science and Engineering Practices

SEP: Developing and Using Models
SEP: Analyzing and Interpreting Data
SEP: Engaging in Argument from Evidence

Common Core Standards for Mathematical Practice

MP 1: Make sense of problems and persevere in solving them
MP 2: Reason abstractly and quantitatively
MP 3: Construct viable arguments and critique the reasoning of others
MP 4: Model with mathematics
MP 5: Use appropriate tools strategically
MP 6: Attend to precision

See the Arcade Entrepreneur Design Challenge Planning Guide for complete alignment details.

ACTIVITY 1

TIME

~50 min

Pat's RFP & the Design Challenge

Essential Question: What is Pat asking us to design, and what would make our game a success?

Students reconnect with Pat and the Pixel Palace context, read Pat's Request for Proposals, and unpack it into a clear design problem with criteria and constraints. Teams form and choose a game type from Pat's menu (or decide to pitch their own). This launches the engineering design process for the unit.

SETUP & MATERIALS

- Print one copy of the Pixel Palace RFP and the Pixel Palace Game Menu per student.
- Have the Design Notebook pages ready (one packet per student).
- Post the engineering design process (EDP) diagram where the class can see it.
- Decide teams of three in advance, or plan a method for forming them today.

Part 1 — Welcome Back to Pixel Palace: 5 min

Open by reminding students who Pat is and what the arcade is. If your class did the earlier units, connect back: "You helped Pat understand the customers (Data Challenge) and design a prize game with a catapult (Systems Challenge). Pat has a new problem for you." If this is your students' first Pixel Palace unit, give the short version: Pat owns a struggling arcade and relies on the design team for new ideas.

Part 2 — Read Pat's RFP: 20 min

Distribute Pat's RFP and read it together. Have students highlight (1) what Pat wants, (2) the rules/limits, and (3) anything they have questions about. Introduce the words criteria (what the design must do) and constraints (the limits it must stay within).

As a class, sort Pat's requirements into criteria and constraints on the board. Students record the class list on their Design Notebook "Problem Definition" page.

DISCUSSION QUESTIONS

1. What is Pat asking your team to design?
2. Which of the five criteria do you think will be the hardest to meet? Why?
3. What data do you think could help you?

TEACHER TIP — KEEP CRITERIA STUDENT-FRIENDLY

Pat's RFP is written so the requirements translate into five plain-language criteria: Fun, Fair, Safe, Buildable, and Profitable. Keep returning to these five words throughout the unit — they become the columns of the decision matrix in Activity 6 and the rows of the final rubric.

Part 3 — Teams & Game Menu: 20 min

Form teams of three. Hand out the Pixel Palace Game Menu and walk through the five options: Ramp Toss /Mini skee-ball, Plinko drop, Marble maze, Ring-or-target toss, and Pitch-Your-Own. Emphasize that every option must be buildable from cardstock and craft materials and must include one custom part the team will design in TinkerCAD.

Teams discuss and record a first choice and a backup on their Design Notebook. They do NOT start building — today is about understanding the problem. Close by previewing the rest of the unit using the Unit Structure list.

EXIT TICKET

- In one sentence, what is Pat asking your team to design?
- List two criteria and one constraint for your game.
- Which game type is your team leaning toward, and why?

ACTIVITY 2

TIME

~50 min

How Arcade Games Work: Market Research

Essential Question: How do existing games stay fun and fair while still making a profit?

Before designing, teams study how real arcade games work. They rotate through example mechanics, notice how difficulty and odds are tuned, and connect the play experience to the math of winning and profit. This research informs the criteria they'll design toward.

SETUP & MATERIALS

- Set up 3–4 example/demo stations if possible (a ramp, a Plinko board, a ring toss, a marble run). Simple versions are fine — even pictures or short videos work.
- Optional: a short teacher-selected video on how arcade games are designed.

Part 1 — Station Rotation or Video Study: 20 min

Teams rotate through the stations (about 5 minutes each) or study the examples on screen. At each one they record: How do you play? How do you win? What makes it easy or hard? What part of the game could be redesigned?

Part 2 — The Math of Fun and Fair: 20 min

Bring the class together and connect play to numbers. Introduce (or review) probability of winning as wins ÷ total plays, and expected profit per play as price to play minus the average prize cost per play. Work one quick example as a class:

1. A ring toss costs $1 to play. About 1 in 5 players win a $2 prize. Average prize cost per play = (1/5) × $2 = $0.40. Expected profit per play = $1.00 − $0.40 = $0.60.
2. Ask: what happens to profit if the game gets too easy? Too hard (and no one plays)?

TEACHER TIP — CONNECT TO PRIOR UNITS / MATH CLASS

If students did the Systems Challenge, this is the same prize-and-profit reasoning applied to a game they get to invent. The new RFP sets target win rates so students have concrete numbers to design toward. Coordinate with the math teacher — probability and expected value reinforce 6th–7th grade statistics standards.

Part 3 — Define “Good” for Our Game: 10 min

Teams revisit the five criteria (Fun, Fair, Safe, Buildable, Profitable) and write a one-line description of what each will look like for their chosen game type. This becomes their design target.

DISCUSSION QUESTIONS

- What design choices make a game feel fair but still profitable?
- Where is the “sweet spot” between too easy and too hard?
- What’s one feature from a station you’d borrow or improve?

ACTIVITY 3

TIME

~50 min

TinkerCAD On-Ramp: Intro to 3D Modeling

Essential Question: How can we use 3D modeling software to design a part precisely?

Students get their first hands-on experience with CAD. Through a guided tutorial they learn the TinkerCAD workspace and the core moves — placing shapes, resizing, moving, rotating, grouping, and using “holes” to cut. No design decisions yet; the goal is fluency with the tool so Activity 4 can focus on their part.

SETUP & MATERIALS

- Set up a TinkerCAD class with a join code (tinkercad.com → Teacher/Classes). Pre-create student logins if your district requires it.
- Test that the site loads on student devices and that login works before class.
- Project your own TinkerCAD screen to demonstrate live.
- Print the TinkerCAD Quick-Start Guide.

Part 1 — Tour the Workspace: 10 min

If students are new to TinkerCAD, demonstrate the basics on the projector: the workplane, the shapes panel, and the view cube for rotating the camera. Have students log in and place their first shape. Keep everyone together at this stage.

Part 2 — Guided Build: A Custom Keychain Tag: 30 min

Lead a step-by-step build that practices every move students will need. A name tag works well because it uses shapes, holes, and text:

3. Drag a box onto the workplane; set its size with the dimension handles (e.g., 40 × 20 × 4 mm).
4. Add a cylinder, switch it to a “hole,” position it near one edge, and group everything to punch a hole for a keyring.
5. Add a text shape, type initials, and resize and position it on the tag.
6. Use rotate and the align tool to center the text.
7. Practice undo, duplicate, and the view cube until the moves feel comfortable.

TEACHER TIP — PACING & PEER HELPERS

Expect a wide range of speeds the first time. Pair fast finishers as “CAD helpers,” and keep the projected steps visible so students can self-pace. It’s fine if the tag isn’t perfect — fluency, not polish, is today’s goal. If devices or internet are unreliable, TinkerCAD also has offline-friendly tutorials built in (the “Starters/Lessons” area).

Part 3 — Save & Reflect: 5 min

Make sure every student has saved a design to their account (TinkerCAD autosaves, but confirm they can find it again). Quick reflect: what was easier than expected? What's still confusing?

ACTIVITY 4

TIME

~50 min

Modeling Your Custom Part in TinkerCAD

Essential Question: What one custom part will make our game work better, and how do we model it?

Each team designs and models one custom part for their game — the piece that makes their design theirs. Students apply the skills from Activity 3 to a real component, paying attention to size and fit so the part will work with their cardstock prototype.

SETUP & MATERIALS

- Students logged in to TinkerCAD with Activity 3 complete.
- Print the Custom Part Planner
- Have rulers available so students can size parts to real-world dimensions.

Part 1 — Choose & Plan the Part: 15 min

Teams decide which single part to model in CAD. Examples by game type:

- Ramp Toss / skee-ball — a scoring ring, a target cup, or a numbered backstop.
- Plinko — a peg, a custom puck/chip, or a scoring bin divider.
- Marble maze — a gate, a funnel, or an obstacle piece.
- Ring/target toss — a custom target topper or a weighted base.
- Pitch-Your-Own — any single defining part, approved by the teacher.

On the Custom Part Planner, teams sketch the part, label its real-world dimensions, and note how it attaches to the cardstock build.

Part 2 — Model It: 30 min

Teams build the part in TinkerCAD, working to the dimensions on their planner. Remind them to use real units (mm) so the part matches their physical prototype. Encourage simple, printable/buildable shapes over fancy detail.

DESIGN CHECK — BEFORE YOU FINISH

- Does the part match the size you wrote on your planner?
- How will it connect to the cardstock build — slot, tab, glue, or stand?
- Could you build or print this realistically, or is it too complex?

Part 3 — Export or Capture: 5 min

Teams either export an STL (if you'll 3D-print) or capture a labeled screenshot of the model for their pitch. Save to the team folder.

TEACHER TIP — PRINTING IS OPTIONAL

If you decide to 3D print students' designs, collect STL files and print overnight in batches; one small part per team is realistic. If you don't, students recreate the part from craft materials using their CAD model as the precise plan — that's an authentic engineering workflow too. The learning goal is designing a part in CAD, not having a final 3D printed part for their prototype.

ACTIVITY 5

Ideation & Concept Sketching

TIME

~50 min

Essential Question: How many different ways could we design our game?

Teams generate several distinct game concepts before committing to one. They sketch designs that show how the game is played, how a player wins, and where the custom part fits. The emphasis is on quantity and variety of ideas — the raw material for the evaluation in Activity 6.

SETUP & MATERIALS

- Provide blank paper, rulers, and colored pencils/markers.
- Post the five criteria (Fun, Fair, Safe, Buildable, Profitable) for reference.

Part 1 — Rapid Idea Generation: 15 min

Run a quick brainstorm: each team member silently sketches two rough game ideas (about 2 minutes each), then the team shares. Rule: no judging ideas yet — get them all on paper. Encourage variation in layout, scoring, and difficulty.

Part 2 — Develop Three Concepts: 25 min

Each team selects and develops three of the strongest, most different concepts into labeled sketches. Each sketch should show the overall layout, how a player plays and wins, the materials, and where the custom CAD part goes. Students label dimensions where they can.

SKETCH CHECKLIST

- Can someone else understand how to play just from your sketch?
- Is it clear how a player wins — and roughly how often?
- Is the custom part shown and labeled?
- Could this be built from cardstock and craft materials?

Part 3 — Share & Stick: 10 min

Teams post their three concepts. Do a quick gallery glance so teams see the range of ideas in the room before they evaluate tomorrow.

ACTIVITY 6

Concept Evaluation & Selection

TIME

~50 min

Essential Question: Which of our concepts best meets Pat's criteria — and how do we know?

Teams use a decision matrix to score their three concepts against the five criteria, turning a gut feeling into a defensible choice. This is the heart of MS-ETS1-2: systematically evaluating competing solutions. Teams select one concept to prototype and justify the decision.

SETUP & MATERIALS

- Print the Concept Evaluation Matrix one per team.
- Teams' three concept sketches from Activity 5 on hand.

Part 1 — Set Up the Matrix: 10 min

Review how a decision matrix works: criteria down the side, concepts across the top, scored 1–5 in each cell, then totaled. Discuss as a class whether any criteria should count more (weighting). For example, Safe might be a "must-pass" gate rather than a score.

Part 2 — Score the Concepts: 25 min

Teams score each concept against Fun, Fair, Safe, Buildable, and Profitable, writing a short reason for each score (not just a number). They total the columns and identify the winner. Encourage debate — if scores are close, that's a real engineering conversation.

DISCUSSION PROMPTS — DEFEND YOUR SCORES

- What evidence (from research or sketches) supports your score for "Fair"?
- Did the highest-scoring concept surprise you? Why or why not?
- Is there a concept you liked but the matrix ranked low? What does that tell you?

Part 3 — Commit & Plan: 15 min

Teams circle their chosen concept and write a one-paragraph justification referencing the matrix. They then make a quick build plan: what to build first, who does what, and what materials they'll need on Day 7.

TEACHER TIP — LET THE DATA WIN

Watch for teams that pick a favorite and reverse-engineer the scores to justify it. Push them to score honestly first, then choose. If a team genuinely disagrees with the matrix result, that’s a great moment — ask what criterion the matrix is missing, and let them add or weight it rather than ignore the tool.

ACTIVITY 7

TIME

2 x ~50 min

Build the Prototype

Essential Question: Can we build a working version of our game

Over two sessions, teams build a working prototype of their chosen game from cardstock and craft materials, integrating their custom CAD part (printed or rebuilt from the model). The goal is a playable version — good enough to test, not a finished product.

SETUP & MATERIALS

- All prototyping materials out and organized (cardstock, craft supplies, cutting tools, tape, glue).
- Custom parts ready: printed STLs, or CAD models displayed so teams can rebuild the part by hand.
- Build plans from Activity 6 on each team's table.
- Establish cutting-tool safety rules before anyone starts.

Part 1 (Day 7) — Build the Core: 50 min

Teams build the main structure of the game — the board, ramp, frame, or maze — and get the play mechanic working in rough form. Remind them: build the thing you can test soonest. A messy but playable version beats a beautiful half-finished one.

SAFETY & BUILD NORMS

- Cutting tools stay on the table; cut away from your body; one cutter per team at a time.
- Test the play mechanic early and often, even while it's rough.
- Keep the custom part's real dimensions — don't shrink it to fit a mistake.

Part 2 (Day 8) — Integrate & Finish for Testing: 50 min

Teams add the custom part, scoring zones, and any details needed to play a full round. They run a few informal trials to make sure the game is testable tomorrow, and fix obvious failures (a ramp too steep, a target that never gets hit).

TEACHER TIP — TIMEBOX THE BUILD

Building can expand to fill any amount of time. Give a clear "must be playable by end of Day 8" deadline and a 10-minute warning each day. Teams that finish early should start sketching their test plan (how many trials, what they'll measure) rather than over-decorating.

ACTIVITY 8

TIME

~50 min

Protype Testing & Data Collection

Essential Question: Is our game fun, fair, and profitable — and how do the numbers prove it?

Teams run structured tests, collect win-rate and profit data, and compare the results to Pat's targets. This is where the math from Activity 2 meets their real design (MS-ETS1-3): data, not opinion, tells them whether the game works.

SETUP & MATERIALS

- Print one Test Data Sheet per team.
- Set a standard number of trials (e.g., 20–30 plays) so teams can compute win rate.
- Decide a play price and prize values as a class, or use Pat's RFP numbers.

Part 1 — Plan the Test: 10 min

Teams decide their testing rules: how many plays, who plays, what counts as a win, and what they'll record. Consistency matters — every trial should follow the same procedure so the data is fair.

Part 2 — Run Trials & Record: 25 min

Teams run their plays, tallying wins and losses on the data sheet. Rotate so multiple players test the game (this surfaces fairness problems a single player would miss). Teams may also collect quick "fun" feedback from testers.

Part 3 — Crunch the Numbers: 15 min

Teams compute their results and compare to Pat's targets:

8. Win rate = wins ÷ total plays. How close is it to Pat's target?
9. Expected profit per play = price to play − (win rate × prize cost).
10. Expected profit per day = profit per play × estimated plays per day.

DISCUSSION PROMPTS — READ THE DATA

- Does your win rate fall in Pat's acceptable range? Too high, too low?
- Is the game profitable at your current price and prizes?
- What did testers say was fun or frustrating? Does the data agree?
- What one change would most improve the numbers?

ACTIVITY 9

TIME

~50 min

Iterate & Improve

Essential Question: How can we use our test results to make the game better?

Teams turn their data into a concrete redesign. They pick the highest-impact problem, make a change, and re-test to confirm it helped — the core engineering habit of iteration (MS-ETS1-4). Every change must be justified by evidence.

SETUP & MATERIALS

- Test data sheets from Activity 8.
- Prototyping materials available for modifications.
- Engineering Notebook

Part 1 — Choose One Change: 10 min

Each team identifies the single most important problem from their data and decides on one specific change to address it (adjust difficulty, change the prize, move the custom part, fix a fairness issue). Record the change and the prediction in your Engineering Notebook: what should happen to the numbers?

Part 2 — Modify & Re-Test: 30 min

Teams make the change and run a second round of trials using the same procedure as before, so results are comparable. They record the new win rate and profit in Engineering Notebooks to the original data.

ENGINEERING NOTEBOOK PROMPTS

- What did we change, and why (cite your data)?
- What did we predict would happen?
- What actually happened to the win rate and profit?
- Did it work? What would we try next with more time?

Part 3 — Lock In the Design: 10 min

Teams decide whether to keep the change or revert, and finalize the version they'll pitch. They note any remaining limitations honestly — engineers report what still isn't perfect.

TEACHER TIP — ONE CHANGE AT A TIME

Resist the urge to let teams change five things at once. Changing one variable and re-testing is what makes iteration meaningful — it's how they'll know which change caused the improvement. This mirrors hypothesis testing from science class.

ACTIVITY 10

TIME

~50 min

Pitch Prep, Final Pitches & Reflection

Essential Question: How do we convince Pat that our game meets the RFP?

Teams prepare and deliver a short pitch to Pat (played by the teacher, a guest, or peer judges), arguing from evidence that their game meets every requirement in the RFP. The unit closes with a gallery walk and individual reflection — and a hook toward what comes next.

SETUP & MATERIALS

- Print the Pitch Planner and the Design Challenge Rubric.
- Set up a space for pitches and a gallery-walk layout for prototypes.
- Optional: invite a guest to play Pat, or use peer judges with the rubric.

Part 1 — Build the Pitch: 20 min

Using the Pitch Planner, teams prepare a 3–5 minute pitch that covers: the problem from Pat's RFP, their game and how it's played, their custom CAD part, their test data and how they used it to iterate, and why the game is fun, fair, safe, buildable, and profitable.

PITCH MUST INCLUDE

- The design problem in Pat's own terms (the five criteria).
- A demo or clear explanation of how the game is played.
- The custom part, shown as a CAD model or printed piece.
- Win-rate and profit data, and the change you made because of it.
- An honest note on a limitation and a next step.

Part 2 — Final Pitches & Gallery Walk: 25 min

Teams pitch to Pat and/or set up for a gallery walk where classmates play each game and score it on the rubric. Encourage specific, kind feedback: one strength and one suggestion per game.

Part 3 — Reflection & Cliffhanger: 5 min

Students complete an individual reflection: what they're proud of, what the data taught them, and how CAD changed their design.

TEACHER TIP — MAKE PAT REAL

The pitch lands best when there's a real audience. A guest "Pat" (an administrator, a parent, an older student) raises the stakes and the quality. If that's not possible, rotate teams as judges using the rubric — being on both sides of the pitch deepens the engineering-argument practice (MS-ETS1, MP3).

Companion Handouts

Handout 1 — Pixel Palace Request for Proposals (RFP)

PIXEL PALACE ARCADE Request for Proposals

From the desk of Pat "Pac" Manning, Owner

To: The Pixel Palace Design Team

Re: We need a brand-new game!

Team — you've helped me before, and I need you again. Business is okay, but customers keep asking, "What's new?" I want an original arcade game that nobody has seen before. I'm officially inviting your design teams to submit proposals. Here's what a winning game has to do:

The Requirements

Fun: People should want to play it again. It should be easy to understand in a few seconds.

Fair: Winning should feel possible but not automatic. Aim for roughly 1 in 4 to 1 in 3 players winning a small prize. Big prizes should be rare.

Safe: No flying objects that could hurt anyone, no sharp edges, nothing that tips over easily.

Buildable: Your prototype must be built from cardstock and craft materials. It must include at least one custom part you design in 3D modeling software (TinkerCAD).

Profitable: At $1 per play, the game should earn me at least $40 in profit on a busy day. Show me the math.

Pitch me your game in 3–5 minutes. Show me your design, your custom part, and your test data — prove it's fun, fair, and good for business.
Make me something great. — Pat

Handout 2 — Pixel Palace Game Menu

Name: ________________________________ Team: ______________ Date: _________

INSTRUCTIONS

- Choose one game type to start from — or pitch your own idea (with teacher approval).
- Every option must be buildable from cardstock and craft materials and must include one custom part designed in TinkerCAD

Game Type	How It Works	Possible Custom Part
Ramp Toss / Mini Skee-Ball	Roll or toss a ball up a ramp into scoring zones or cups.	Scoring ring, target cup, numbered backstop
Plinko Drop	Drop a chip down a pegboard; where it lands sets the prize.	Custom peg, puck/chip, or scoring-bin divider
Marble Maze	Guide a marble through a maze or course to a goal.	Gate, funnel, or obstacle piece
Ring / Target Toss	Toss rings or beanbags onto targets of different values.	Target topper or weighted base
Pitch-Your-Own	*Your team's original idea that still meets all RFP requirements.*	*Any single defining part (teacher-approved)*

Our Game Choice: ____

Game name (you'll come up with this):

____

Our custom part idea:

____

One thing that makes our game FUN:

____

Handout 3 — TinkerCAD Quick-Start Guide

A pocket reference for the moves you will use most. Keep it handy while you work.

Action	How to Do It
Place a shape	Drag it from the right-hand Shapes panel onto the workplane.
Resize	Drag the white corner handles. For exact sizes, type dimensions in the boxes that appear (use mm).
Move up / down	Drag the small black cone arrow above a shape, or type a value in the height box.
Rotate	Click the shape, then drag the curved rotation arrows that appear around it.
Make a hole	Select a shape and click Hole in the inspector. Group it with a solid shape (Ctrl+G) to cut out a hole.
Group / Ungroup	Select multiple shapes → Ctrl+G to combine into one. Ctrl+Shift+G to separate.
Align	Select shapes → use the Align tool to center or edge-align them.
Camera / View	Use the view cube (top-right corner) to orbit; press the Home icon to reset to default view.
Save / Export	TinkerCAD autosaves to your account. Use Export → .STL to print, or take a screenshot for your pitch.

Design Tips for Your Custom Part:

- Build small first — start with the basic shape, then add detail.
- Measure twice: note real-world dimensions in mm before you model.
- Use the Hole tool to create slots, notches, or cutouts for tabs.
- Test fit: if 3D printing, add 0.5 mm tolerance to slots and holes.

Handout 4 — Custom Part Planner

Name: ________________________________ Team: _____________ Date: _________

INSTRUCTIONS
• *Plan your part before you start modeling in TinkerCAD.* • *The clearer your plan, the faster and more accurate your model will be.*

What part are you designing?
What is its job in the game?
How will it attach to your cardstock build? **(circle one: slot · tab · glue · stand · other: ________)**
Will you 3D-print it, or rebuild it by hand from craft materials?

Sketch Your Part Here (label real-world dimensions in mm):

KEY DIMENSIONS		
Dimension	**Planned Size (mm)**	**Notes**
Overall length		
Overall width		
Key slot / hole size		

Handout 5 — Concept Evaluation Matrix

Name: ________________________________ Team: ______________ Date: _________

INSTRUCTIONS

- Score each concept 1 (weak) to 5 (strong) on every criterion.
- Write a short reason for your score, then total each column.
- The concept with the highest total is your strongest option — but talk about it as a team before you make a final decision.

Criterion **(1 = weak · 5 = strong)**	**Concept A** **Name: _________**	**Concept B** **Name: _________**	**Concept C** **Name: _________**
Fun **Will players want to play again?**	Score: ___ Reason:	Score: ___ Reason:	Score: ___ Reason:
Fair **Is winning possible but not automatic?**	Score: ___ Reason:	Score: ___ Reason:	Score: ___ Reason:
Safe **No hazards; easy to supervise?**	Score: ___ Reason:	Score: ___ Reason:	Score: ___ Reason:
Buildable **Can we build it in class?**	Score: ___ Reason:	Score: ___ Reason:	Score: ___ Reason:
Profitable **Will it earn ≥ $40/day at $1/play?**	Score: ___ Reason:	Score: ___ Reason:	Score: ___ Reason:
TOTAL (out of 25)	_____ / 25	_____ / 25	_____ / 25

OUR CHOICE:

We choose concept ________ because ____

Handout 6 — Test Data Sheet

Name: ________________________________ Team: ______________ Date: _________

INSTRUCTIONS

- Run the same procedure every trial. Tally each play as a win (W) or a loss (L), then compute your results.
- Run at least 20 trials per testing session.

Game name: ______________________ Price to play: $_____ Small-prize value: $_____

Trial	**Result (W / L)**	**Notes** *(use for observations)*
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
TOTALS - Wins: _____ Losses: _____ Total plays:__________		

PROFIT CALCULATIONS	
Win rate (%)	Wins ÷ Total plays × 100 = ________ %
Profit per play ($)	Price − prize cost − operating cost = $ ________
Estimated plays per day	________
Estimated daily profit ($)	Profit/play × plays/day = $ ________

TESTER FEEDBACK

What was fun? YES NO

If yes, what made the game fun? If no, why do you think it wasn't fun?

What was frustrating or confusing?

What would make you play again?

Handout 7 — Pitch Planner

Name: ________________________________ Team: ______________ Date: _________

INSTRUCTIONS

- Plan a 3–5 minute pitch to Pat.
- Every team member should speaks at least once.
- Fill in notes and assign each part to a group member.
- Practice your pitch at least 2 times.

	Notes
1. The Problem *In Pat's words, what does our game need to do? (Reference all five criteria.)* Assigned to:	
2. Our Game *What is it, how do you play, and how do you win?* Assigned to:	
3. Our Custom Part *What did we design in TinkerCAD, and why does it make our game better?* Assigned to:	

4. Our Data *What was our win rate and estimated profit? What change did we make after testing, and why?* Assigned to:	
5. The Case *Why is our game fun, fair, safe, buildable, and profitable? (Back each claim with evidence.)* Assigned to:	
6. Honest Reflection *One limitation of our design, and what we would try next if we had more time.* Assigned to:	

Handout 8 — Design Challenge Rubric

Assessment type (circle one):

Self-assessment · Peer assessment · Teacher assessment

Category	1 Beginning	2 Approaching	3 Meets	4 Exceeds	Score
Design Process	Does not show evidence of EDP steps.	Shows some steps but skips criteria/ideation.	Defined criteria, generated multiple concepts, used matrix to select one.	Defined criteria precisely, generated 3+ distinct concepts, justified choice with data.	____/4
Custom CAD Part	No TinkerCAD model or unrelated to game.	Model exists but does not fit the game or has major sizing errors.	Designed an appropriate part in TinkerCAD, sized to fit the build.	Part is well-designed, clearly improves game, successfully integrated into the prototype.	____/4
Prototype	Game is not playable or not built.	Game is partially built; missing custom part or major structural issues.	A playable game built from cardstock/craft materials that integrates the custom part.	Game is well-crafted, clearly playable, and integrates custom part seamlessly.	____/4
Data and Iteration	No test data collected.	Some data collected but no evidence-based change was made.	Collected win-rate and profit data; made one evidence-based change and re-tested.	Robust data set; change is clearly justified by data; re-test confirms improvement.	____/4
Meets the RFP	Game does not address Pat's criteria.	Game meets 1–2 of the 5 RFP criteria.	Game meets 3-4 of the 5 RFP criteria.	Game meets all 5 RFP criteria.	____/4
Pitch and Teamwork	Pitch is missing or only one member presents.	Pitch is present but lacks structure or evidence; not all members speak.	Clear 3–5 min pitch; all members contributed; argued from data and design evidence.	Polished, persuasive pitch; all members contribute meaningfully; evidence is specific and compelling.	____/4

TOTAL SCORE: _____ / 24

Strengths:

Areas to improve:

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