ARCADE ENTREPRENEUR · 6TH GRADE DESIGN CHALLENGE

Planning Guide

Duration: ~11 Class Periods | Grade 6

Activity Overview and Pacing

Activity	Name	Day	Time	Essential Question
1	Pat's RFP and the Design Challenge	Day 1	~50 min	What is Pat asking us to design, and what does success look like?
2	How Arcade Games Work: Market Research	Day 2	~50 min	How do existing games stay fun, fair, and profitable?
3	TinkerCAD On-Ramp: Intro to 3D Modeling	Day 3	~50 min	How can we use 3D modeling software to design a physical part?
4	Ideation and Concept Sketching	Day 4	~50 min	How many different ways could we design a game that meets all five criteria?
5	Concept Evaluation and Selection	Day 5	~50 min	Which of our concepts best meets Pat's five criteria?
6	Plan, Model, and Build the Prototype	Days 6–8	~3 × 50 min	Can we plan, model, and build a working version of our game?
7	Prototype Testing and Data Collection	Day 9	~50 min	Is our game fun, fair, and profitable?
8	Iterate and Improve	Day 10	~50 min	How can we use our test results to make the game better?
9	Pitch Prep, Final Pitches, and Reflection	Day 11	~50 min	How do we convince Pat that our game is the right choice?

Activity Descriptions and Materials

Activity 1 — Pat's RFP and the Design Challenge | Day 1 | ~50 min

Essential Question: *What is Pat asking us to design, and what does success look like?*

Students read Pat's RFP, review the Game Menu of permitted game types, form teams, and identify the five design criteria (fun, fair, safe, buildable, profitable) and constraints. The EDP poster is introduced: teams locate themselves at the 'Identify the Problem' stage.

Materials:

- Handout 1 — Pat's RFP
- Handout 2 — Pat's Game Menu
- EDP Poster
- Engineering Design Logs

Activity 2 — How Arcade Games Work: Market Research | Day 2 | ~50 min

Essential Question: *How do existing games stay fun, fair, and profitable?*

Students study 3–4 sample arcade game stations or watch curated video clips to analyze how game mechanics create the right odds of winning. They define 'good' game design through the lens of Pat's five criteria. Teams connect to the 'Understand' stage of the EDP.

Materials:

- Sample game station materials or video links
- Engineering Design Logs

Activity 3 — TinkerCAD On-Ramp: Intro to 3D Modeling | Day 3 | ~50 min

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

Students learn TinkerCAD fundamentals by building a custom keychain tag. They practice every core move — place, resize, move, rotate, cut holes, group, align — before using TinkerCAD to model their actual custom part in Activity 6.

Materials:

- Computers or Chromebooks with TinkerCAD access
- Handout 3 — TinkerCAD Quick-Start Guide

Activity 4 — Ideation and Concept Sketching | Day 4 | ~50 min

Essential Question: *How many different ways could we design a game that meets all five criteria?*

Teams generate at least three distinct game concepts. Crucially, each concept sketch includes not just the game mechanics but also a rough idea of what custom part that concept would require. This connects ideation to fabrication before any commitment is made. Teams are at the 'Ideate' stage of the EDP.

Materials:

- Paper/sketchbooks for concept sketches
- Sticky notes for gallery share-out

Activity 5 — Concept Evaluation and Selection | Day 5 | ~50 min

Essential Question: *Which of our concepts best meets Pat's five criteria?*

Teams score each concept against all five criteria using the Concept Evaluation Matrix, discuss trade-offs, and commit to one design — including confirming the custom part they will model and build. They plan next steps. This is the 'Evaluate' stage of the EDP.

Materials:

- Handout 4 — Concept Evaluation Matrix
- Concept sketches from Activity 4

Activity 6 — Plan, Model, and Build the Prototype | Days 6–8 | ~3 × 50 min

Essential Question: *Can we plan, model, and build a working version of our game?*

Three-session build block. Day 6: Teams use the Custom Part Planner to finalize their part design, then model it in TinkerCAD to precise dimensions. Day 7: Teams build the main cardstock structure of their game. Day 8: Teams integrate the custom part, add scoring zones, and prepare the game for testing. This is the 'Prototype and Test' stage of the EDP.

Materials:

- Handout 5 — Custom Part Planner
- Computers with TinkerCAD (Day 6)
- Prototyping materials (Days 7–8) — Card Stock, Jumbo Craft Sticks, Pipe Cleaners, Paper Straws, Craft Pom-Poms, Ping-Pong Balls, Paper Cups; Small Metal Rulers and Cloth Measuring Tape for measuring; plus tape, scissors, glue, and cardboard.
- Optional: 3D printer for custom part

Activity 7 — Prototype Testing and Data Collection | Day 9 | ~50 min

Essential Question: *Is our game fun, fair, and profitable?*

Teams run at least 20 standardized playtests using the Test Data Sheet, recording wins/losses, fairness ratings, and player feedback. They calculate actual win rate and estimated profit per play, continuing the 'Prototype and Test' stage.

Materials:

- Handout 6 — Test Data Sheet
- Calculators
- Completed prototypes

Activity 8 — Iterate and Improve | Day 10 | ~50 min

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

Based on playtest data, each team chooses one targeted change, modifies the prototype, and re-tests to confirm the improvement. They document the iteration on their Test Data Sheet. Teams remain in the 'Prototype and Test' stage until they finalize their design.

Materials:

- Test Data Sheet from Activity 7
- Prototyping supplies for modifications

Activity 9 — Pitch Prep, Final Pitches, and Reflection | Day 11 | ~50 min

Essential Question: *How do we convince Pat that our game is the right choice?*

Teams prepare and deliver a 3–5 minute pitch integrating their RFP analysis, TinkerCAD model, test data, and iteration story. A gallery walk gives peers time for written feedback. The unit closes with a class reflection on the full EDP cycle students just completed — from identifying the problem to communicating their solution.

Materials:

- Handout 7 — Pitch Planner
- Handout 8 — Design Challenge Rubric
- Completed prototypes and data sheets

Standards Alignment

This unit was designed to support the Next Generation Science Standards (NGSS) Engineering Design performance expectations and Science & Engineering Practices, and the Common Core Standards for Mathematical Practice (SMP). The tables below summarize the strongest alignment points and where they show up in the challenge. The NGSS engineering design performance expectations (MS-ETS1-1 through MS-ETS1-4) are the backbone of this unit and map cleanly to most state engineering and technology standards. If your state uses different standards (e.g., Georgia Standards of Excellence, TEKS, NYS Next Generation Standards), align using the descriptions in the tables below.

NGSS Engineering Design Performance Expectations

Standard	Description	Where It Shows Up	Classroom Connection
MS-ETS1-1	Define the criteria and constraints of a design problem with sufficient precision.	Activity 1	Students analyze Pat's RFP to define the design problem, identify five specific criteria, and extract constraints before generating any solutions.
MS-ETS1-2	Evaluate competing design solutions using a systematic process.	Activity 5	Teams use the Concept Evaluation Matrix to score three concepts against Pat's five criteria before selecting one to build.
MS-ETS1-3	Analyze data from tests to determine similarities and differences among design solutions.	Activities 7–8	Teams analyze playtest data to evaluate game performance and identify which design element to change during iteration.
MS-ETS1-4	Develop a model to generate data for iterative testing and modification.	Activities 6–8	Teams develop both a TinkerCAD CAD model and a physical cardstock prototype, using both to test and iterate their design.

Science and Engineering Practices

Standard	Where It Shows Up	Classroom Connection
SEP: Developing and Using Models	Activity 6 (Day 6)	Teams build a 3D CAD model of their custom part in TinkerCAD to represent and refine their design before physical construction.
SEP: Analyzing and Interpreting Data	Activities 7–8	Teams collect and interpret playtest data (win rate, profit, feedback) to evaluate and improve their game.
SEP: Engaging in Argument from Evidence	Activity 9	Teams pitch their design to Pat, using data and design reasoning to argue that their game meets all five criteria.

Common Core Standards for Mathematical Practice

Standard	Where It Shows Up	Classroom Connection
MP 1: Make Sense of Problems and Persevere	Throughout	The open-ended RFP requires sustained effort across 11 sessions; teams refine their understanding and design iteratively.
MP 2: Reason Abstractly and Quantitatively	Activities 5 and 7	Students reason about win rates, profit per play, and decision matrix scores in the arcade context.
MP 3: Construct Viable Arguments and Critique	Activities 5 and 9	Teams defend concept choices in the decision matrix and present evidence-based arguments in the final pitch.
MP 4: Model with Mathematics	Activity 7	Students model game economics: probability of winning and expected profit per play.
MP 5: Use Appropriate Tools Strategically	Activities 3, 6–7	Students choose and use TinkerCAD, measuring tools, and prototyping materials purposefully.
MP 6: Attend to Precision	Activities 6–7	Accurate measurements are critical for the TinkerCAD model, physical build, and consistent playtest procedure.

This STEM Innovation and Design module was produced by Georgia Institute of Technology's Center for Education Integrating Science, Mathematics, and Computing with support from National Science Foundation Award #2101441.