

Project 20
Chess Game Design
Intro to Tech Math

Category	Standards Aligned	Point Total	100%	50%	0	Score
Chess Practice	SFMP.7 Look for and make use of structure. SFMP.8 Look for and express regularity in repeated reasoning. PDE Standards for Technology (Page 2)					
Knowledge of Basic Chess	SFMP.4 Model with mathematics.	9				
Secrets of Chess Investigation	SFMP.2 Reason abstractly and quantitatively.	16				
Assigning Values to Chess Pieces	SFMP.4 Model with mathematics. SFMP.7 Look for and make use of structure.					
Design Principles: Initial Google Form	SFMP.1 Make sense of problems and persevere in solving them. SFMP.3 Construct viable arguments and critique others.	7				
Design a New Chess Board	SFMP.4 Model with mathematics.	25				
Making Chess Board Instructions	SFMP.4 Model with mathematics. SFMP.5 Use appropriate tools strategically. SFMP.7 Look for and make use of structure.	10				
Draft of Piece on Paper	SFMP.5 Use appropriate tools strategically.	10				
Creation of Piece on TinkerCAD	3.2.12.D 3.6.12.C	15				
Iteration, Playtesting, Trial and Error	SFMP.1 Make sense of problems and persevere in solving them. SFMP.3 Construct viable arguments and critique others.	20				
Rules Explanation Info Card	SFMP.6 Attend to precision.	30				
	Unit Total:	/				

Chess Practice

We will begin this unit by practicing Chess. You may play in person, or you may want to play online.

Online Play

1. <https://www.mathsisfun.com/games/chess.html>

Make sure you think about these following things as you play chess.

Knowledge -- Facts, principles, theories and laws verifiable through scientific inquiry by the world community of scientists.

- What are the rules of the game?
- How do pieces interact?

Inquiry -- An intellectual process of logic that includes verification of answers to questions about and explanations for natural objects, events and phenomena.

- Figure out what your opponent's move is based on your move?
- What is the best, most powerful move I can make on my turn?

Process Skills -- Recognition by students how knowledge is acquired and applied in science by observing, classifying, inferring, predicting, measuring, computing, estimating, communicating, using space/time relationships, defining operationally, formulating hypotheses, testing and experimenting, designing controlled experiments, recognizing variables, manipulating variables, interpreting data, formulating models, designing models and producing solutions.

- What is your strategy to win?

Problem Solving – Application of concepts to problems of human adaptation to the environment that often leads to recognition of new problems; has social implications and leads to personal decision-making and action; a process which forms the link for interactions between scientific and technological results or findings; involves operational definitions, recognizing variables, formulating models and asking questions.

- How will your strategy change as you adapt to the movements of your opponent's pieces?

Knowledge of Basic Chess Quiz

Go to google classroom and complete the quiz on your knowledge of the base rules of chess. You do not need to know every competitive rule, just enough to start playing.

Secrets of Chess Questions

Answer these questions in a Google Document and Submit them to the Google Classroom Assignment.

1. What pattern do you notice about how the Bishop moves? What about the Knight?
2. Is there any space the Knight cannot land on? It may take a long time to get there, but is it still possible?
3. Can the Pawn land on any space? Think about how it moves, and where it goes when it captures an opponent's piece.
4. Can the Knight move around the board and land on each space only once? (if the knight is the only piece on the board)
5. Can Bishops capture other Bishops?
6. What is *en passant* in chess? What is its purpose?
7. What is *Castling* in chess? What is its purpose?
8. How many Queens can you fit on an empty chess board at once without them being in line of sight of any other Queens?
9. What location on the board is the most valuable to have your pieces placed so you have the most control over the game? Why?
10. What is the best move to make on your first turn? Why?
11. If your opponent makes the move you described in the previous question on the first turn, what is the best move you can make in response?
12. What is the best piece in the whole game? Why?
13. How valuable is it to go first when you play chess? Is it a huge advantage or is it a disadvantage in some way? Why?
14. Is it always valuable to sacrifice your piece in order to capture an opponent's piece? Why or why not?
15. What are some interesting ancient Chess pieces you don't see in Modern Chess? Which one is your favorite? Include a picture.
16. How short was the shortest game of Chess in history? Describe how it went.

Assigning Values to Chess Pieces

Your grade for this is based on your participation. We will discuss the relative value of chess pieces, assign them numbers, then compare all other chess pieces to them. We will create a plot of all values.

1. We will find the class average value of each piece.
2. We will Compare existing, ancient, and fictional chess pieces.

Design Principles (Google Form)

Your piece CANNOT be more powerful than a Queen.

- 1) Circle One: Is your design idea **Top-Down** or **Bottom-Up**?

Top-Down refers to creating the flavor, then adding the mechanics.

Ex: I want to make a piece called the Alligator and it will bite down on and hold pieces in place. I will work out the details of the mechanics later.

Bottom-Up refers to creating the mechanics and finding flavor that fits it later.

Ex: I want to make a piece that can move diagonally 3 spaces and can jump over other pieces. I will come up with a name and flavor later.

- 2) What is your initial idea for a chess piece and what does it do?
- 3) Explain what the **Flavor** of your piece is and why you chose it.
- 4) Does playing your piece feel like the thing you named it? How can you make sure that feeling is felt for sure?
- 5) When a player plays this piece, what decisions are they making? How many decisions are available to them with this piece? **YOU CANNOT SAY "WHERE TO MOVE AND CAPTURE"**.
- 6) What **Strategy** do you want people to use when they play this piece? How is it different from a Pawn, a Knight, or a Queen?
- 7) What is it that makes my piece **Valuable**?
- 8) What number will you value your piece at? It CANNOT be better than a Queen.
- 9) What problem with Chess did you design this piece to solve? (Problem Solving)
- 10) What are some names you've been thinking of for this piece?
- 11) What assumptions about Chess is your piece breaking down? How is it being unique compared to all Modern Chess pieces?

Design a New Chess Board

You will design a new chess board that must be different from the Modern Chess board on a big sheet of poster paper. ***It cannot be a square or rectangle without missing massive points.***

Start Conditions: For the final graded portion of this section, you must decide the starting conditions for each piece in Modern Chess on this board. This is in the form of a diagram on the back of the chess board. Draw it on paper NEATLY and glue it to the back. Trim the paper to fit.

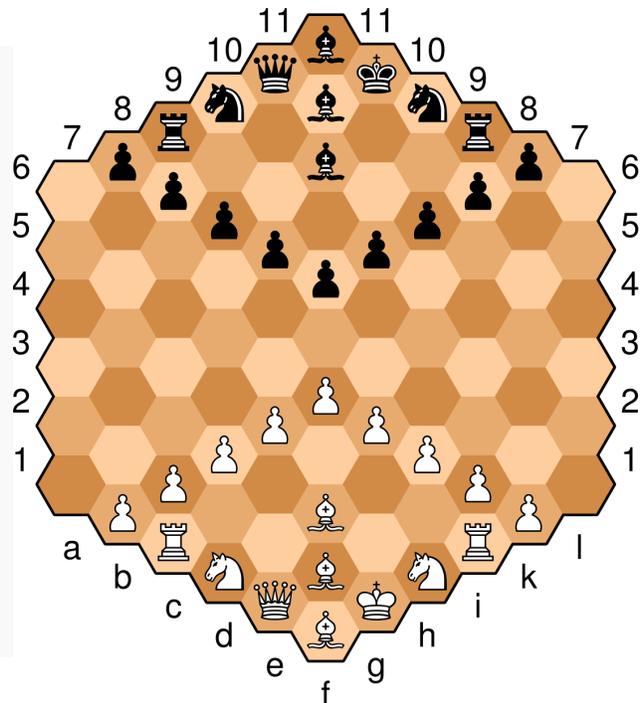
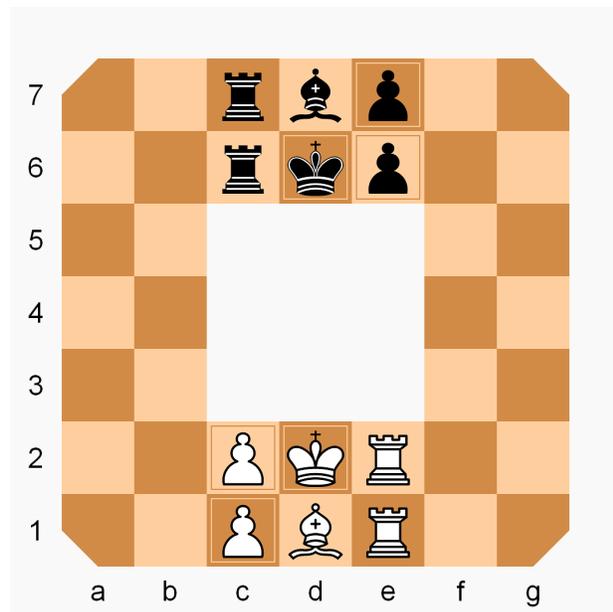
Criteria	Points	100%	0%	Score
Neat and Organized	5	Lines are straight. Angles are Right Angles. Squares are about 1 inch by 1 inch.	Lines are messy. Angles are poor. Squares are wonky, non square, and not all the same.	
Size	5	Board is nearly the same size as the regular board, or has enough spaces to make the size of it appropriate.	The board is too small or too big.	
Shape	2	Shape is unique. Pieces are able to traverse the board.	Shape is uninspired or is a square/rectangle. Board is unplayable.	
Color	3	Alternating spaces are colored differently.	No color or disorganized coloring.	
Start Conditions	10	Diagram includes all 32 pieces. Looks analogous to a modern chess board. Neat and legible.	Less than half the pieces have assigned positions. Rushed, sloppy, illegible.	
Quality of Directions	10	They are typed. Submitted on time. Organized neatly. Includes a distinguished and large title at the top. Includes your name. Correct spelling, grammar, punctuation.	Poorly handwritten. Turned in late. Poorly organized. No title. Missing your name. Poor spelling, grammar, punctuation.	
			Total:	/35

Designing a Chess Board - Mood Board

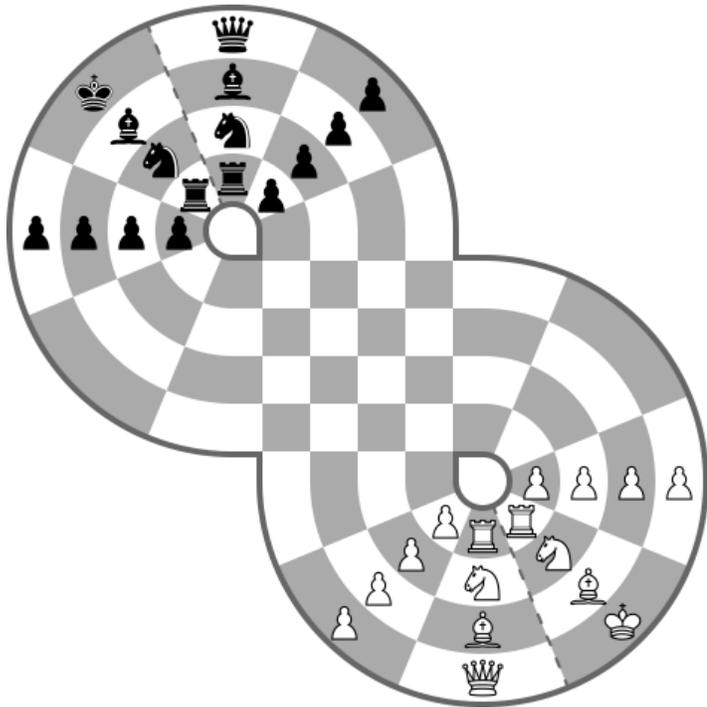
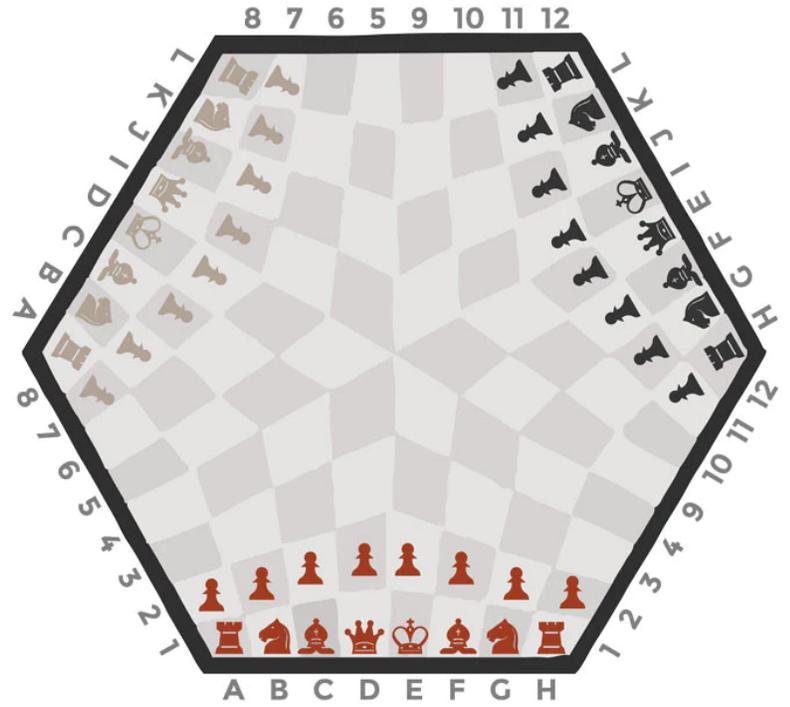
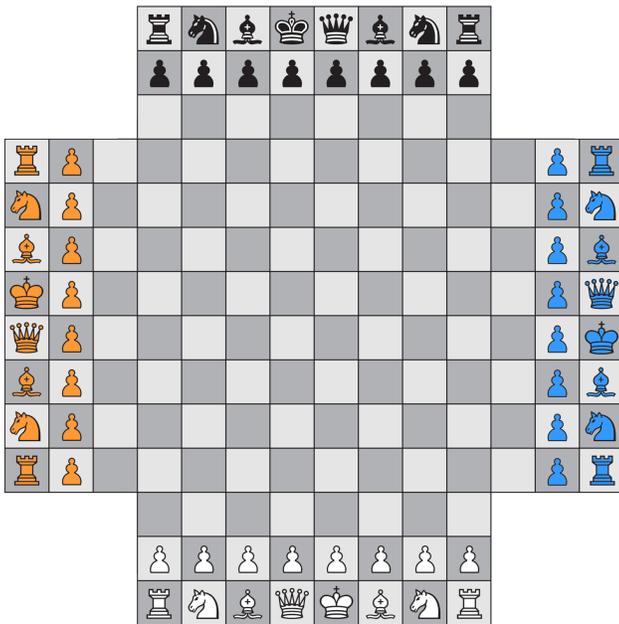
If you have ever seen or played Settlers of Catan, you know the game looks like the first image. But there exist variant boards based on real locations, like in the second photo.



You are doing the same thing with a chess board. You should draw inspiration from the following Chess Board Variants. (*Rollerball and Hexagon Chess*).



Other Chess Variants



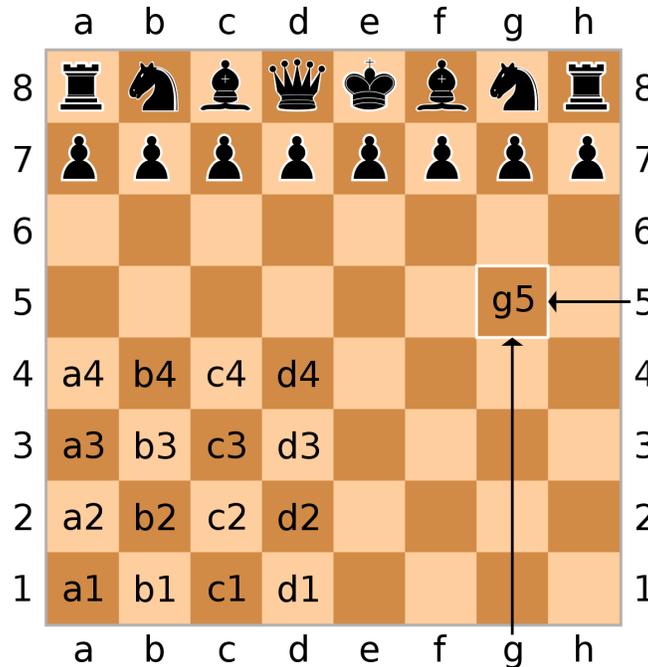
Making Chess Board Instructions (10 points, included in Chessboard Grade)

Now that your chess board is done, you must make a page of instructions to glue to the underneath or your board. **Your directions must be clear, proofread, spelled correctly, and have proper grammar.**

You must now decide where all modern chess pieces will start on your board.

- Where are the rows of Pawns?
- Where does the King and Queen start?
- How can I represent Rooks starting "in the corner"?
- Do your Bishops start on the same color square?
- **How can you make your board display a starting setup that most closely resembles Modern Chess set up?**

You must also create a **Grid System** for your board. Look how Modern Chess does this.



It must also include:

- The name of your board in big text at the top.
- Your name.
- **Grid System** around the border.
- **Instructions** on how to read the grid system. If you have a grid, explain how to read it. If you have a weird type of board, explain it thoroughly.
- Where a **full set of modern chess pieces** start on your board. **Use your grid system** to explain exactly where each piece starts.
 - **Two Rooks**
 - **Two Bishops**
 - **Two Knights**
 - **A King and Queen**
 - **8 Pawns (or at least a row of pawns)**
- **Any special rules** you came up with that go with your board.

Example Grid Systems for Starting Conditions

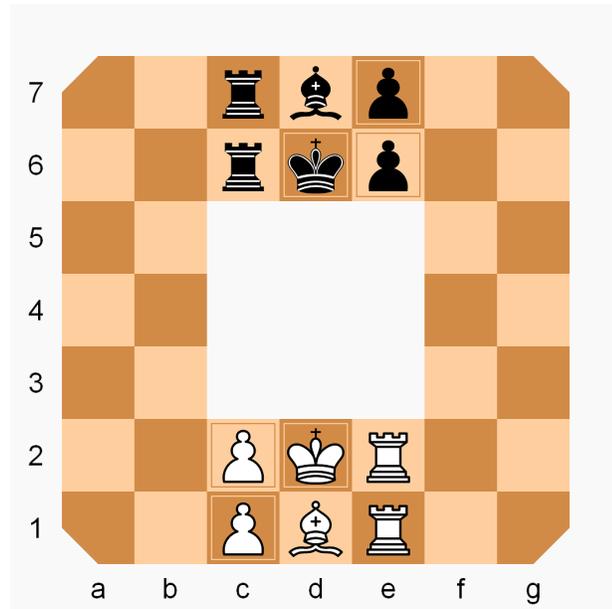
Rollerball

Black

- Rooks: C6 and C7
- Bishop: D7
- King: D6
- Pawns: E7 and E6

White

- Rooks: E1 and E2
- Bishop: D1
- King: D2
- Pawns: C1 and C2



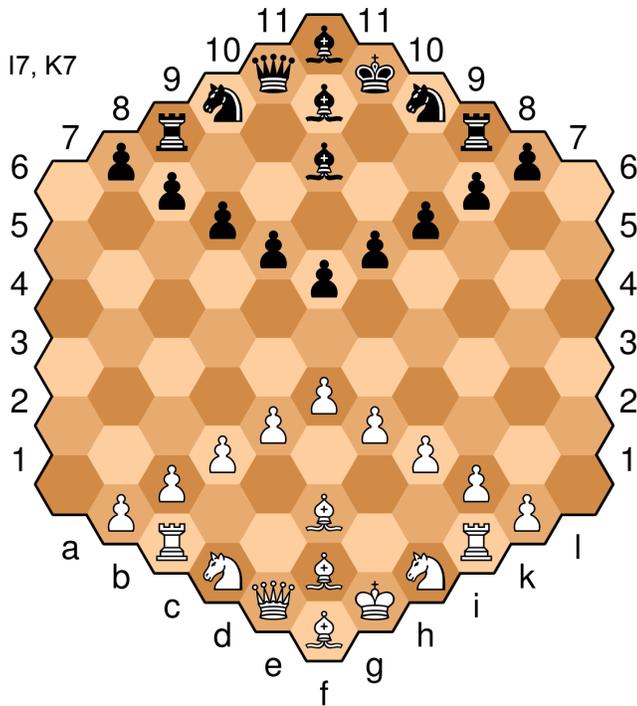
Hexagonal Chess

Black

- Pawns: B7, C7, D7, E7, F7, G7, H7, I7, K7
- Rooks: C9, I9
- Knights: D10, H10
- Bishops: F9, F10, F11
- King: G10
- Queen: E10

White

- Pawns: B1, C2, D3, E4, F5, G4, H3, I2, K1
- Rooks: C1, I1
- Knights: D1, H1
- Bishops: F1, F2, F3
- King: G1
- Queen: E1



Building the Piece

- 1) Create a draft of your piece. Draw three showing the three different perspectives:
 - Front View, Side View and Top-Down (all three orthographic images). Turn this in with your project.
 - Straight lines where necessary, curved lines and details included
 - Accurate angles

- 2) Create your piece on TinkerCAD.com.

TinkerCAD Piece Requirements:

- Must look like other chess pieces.
- Must be made of Basic Shapes
- Don't make it too detailed, the piece will print very small.
- Must have a circular base with one of the following sizes
 - ½ inch (14 mm) radius
- The piece must look something like the name or flavor of your design
 - Ex: the knight piece looks like a horse, the queen looks like a crown.

Criteria	Pts	Full Credit	Half Credit	Zero Credit
Similarity	1	Looks like other chess pieces.		Looks too wacky to fit in with other pieces.
Detail	2	Is not too detailed.		Too detailed for its size.
Base	2	Base is 1in x 1in.		Base is too big or too small.
Flavor	5	Piece looks like its name.		Piece does not look like its name.
Basic Shapes	5	Piece is made entirely out of Basic Shapes.	Piece involves 1 or more objects that are not from the Basic Shapes folder.	Piece involves 2 or more objects that are not from the Basic Shapes folder.
Total	15			

Iteration, Playtesting, and Trial & Error

Students get 5 points for each complete form of Playtesting Questions, 20 points total.

You must play at least 5 partial games of chess with your piece and document your thoughts and adjustments. Make sure you know what your piece is like at the start of the game and at the end of the game.

Jesse Schell is a game designer that wrote *The Art of Game Design*. He poses these questions about playtesting.

1. Why are you playtesting?
2. Who should be playtesting?
3. When should you playtest?
4. What should you look for?
5. How should you conduct the playtest?

Take notes on a separate piece of paper. Turn them in with your project.

Make sure you make note of the following:

- How was your piece at the start of the game?
- How was your piece at the end of the game?
- How much did your piece dominate in the game? Or did it have little impact?
- Did you win or lose the game? Was the game a close call or a slaughter?
- Who did you play against?
- Is your piece fair?
- How strong is it compared to all the other pieces? Is it closer to a Pawn or a Queen?
- Did your piece have any weird conflict with other pieces?
- Was your piece any fun to play? Or fun to play against?

Try these things by Trial & Error:

- Where your piece starts the game.
- What pieces it replaces.
- How it moves.
- How it captures.
- How it gets captured.
- Anything else you think might be interesting.

Game Number _____

1	How did your piece perform at the start of the game?	
2	How did your piece perform at the end of the game?	
3	How much did your piece dominate the game? Or did it have little impact?	
4	Did you win or lose? What part did your piece play in your win or loss?	
5	Who did you play against?	
6	Is your piece fair? Does it need to be powered up or powered down? (Buff vs Nerf)	
7	How strong is it compared to other pieces? The Pawn? The Queen?	
8	Did your piece have any weird conflict with other pieces?	
9	Was your piece any fun to play? Or play against?	
10	Where did your piece start the game? Did it replace a piece?	
11	Other notes	

Rules Explanation Info Card

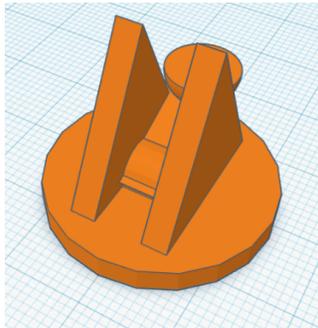
You will need to use Canva to create your finished product. You can find this in Clever.

1. Open Canva. Under the list of documents in "You Might Want to Try..." click on the **Poster 18x24**.
2. Name your file at the top like this:
 - a. [YOUR NAME] [PIECE NAME] Chess Poster
3. Pick a Template off to the left that you like.
4. Start Editing with your information.

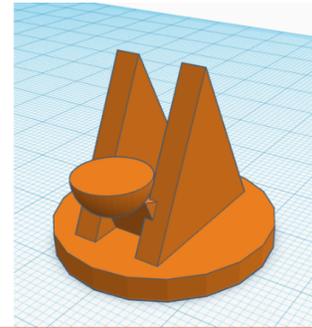
Your document needs to include the following explanations:

1. The name of the piece.
2. Your name, give yourself credit.
3. At least 5 pictures. Two must be of your piece from TinkerCAD from different perspectives.
4. Where does your piece start? What does it replace on the normal starting chess board, if at all? Why do you have it start there? How many of these pieces are there?
5. Describe the **Flavor** of your piece. This is the explanation of why your mechanics connect to the name of the piece.
6. How does your piece move?
7. How does your piece capture? How does your piece get captured?
8. What is the Point Value of capturing your piece? Compare your piece to the power and Point Value of the following and assign your piece a value. Explain your reasoning.
 - a. Pawn - 1 pt
 - b. Knight, Bishop - 3 pt
 - c. Rook - 5 pt
 - d. Queen - 9 pt
9. The general strategy that you will use while playing with this piece.
10. Why you chose to design it the way you did?

Info Card Example



THE CATAPULT



THE LOOK
This piece represents a Catapult or Trebuchet.

It represents launching people out of the catapult to hit opponent's pieces.

MOVEMENT AND STARTING POSITION
The catapult only moves forward 1 space. It cannot move backwards.

Catapults start B3 and G3, then at B6 and G6.

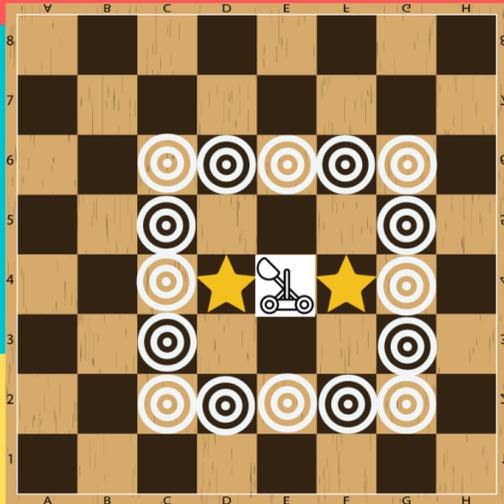
CAPTURING
Any piece to the left or right of the catapult (stars) can be moved to any space exactly 2 spaces away Orthogonally and Diagonally (targets), and captures the piece it lands on.

See Diagram Below.

THE DESIGN
I gave the piece a base of 1 inch diameter.

It is made of two standing triangles with a launch arm between them. The launch arm is made of a triangle, semicircle, and cylinder.

This was designed in TinkerCAD.



STRATEGY
By moving the catapult forward, you are stopping the opposing catapult from moving forward, but you are also making it harder to move your pieces towards the catapult to get launched.

The Catapult can target and control the center of the board from the beginning of the game, but at a cost.

While using the Catapult, pieces get moved around a lot more. You can launch a powerful piece into a powerful position.

CHECKMATE?
A King in range of the Catapult while there are no pieces beside it does not put the King in Check.