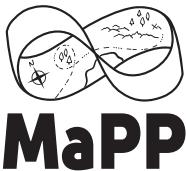




# **MaPP Challenge '20 – Mindy Jonas and the Enigmatic Legacy**

*Mathematical Puzzle Programs*



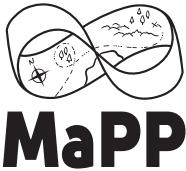
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MaPP Challenge '20 – Mindy Jonas and the Enigmatic Legacy

# Campus Guidelines

Here are some guidelines for local campuses on how to prepare for and run the event.

## Schedule Template

- 0:00 - Staff arrives
- 0:15 - Team check-in
- 0:45 - Orientation
- 1:00 - Game Begins
- 4:00 - Game Ends
- 4:15 - Wrap-Up and Awards
- 4:30 - Dismissal

## Volunteers

Only a handful of volunteers are required to run Game Control. We recommend having 2-5 volunteers depending on the number of participating teams.

## Classroom Space

A large **lecture hall** is recommended for running Check-in, Orientation, and the Wrap-Up. Game Control can be stationed there during the game as well, or another nearby classroom.

Each team should be given a separate **classroom** so that they may openly collaborate with teammates without spoiling puzzles for other teams. It is useful to affix **printed signs** on each classroom and Game Control to help players navigate your space, as well as any additional signage required to get around.

## Team Supplies

**Scissors and tape** should be provided in each classroom. In addition, **chalk or whiteboard markers** should be provided if teams will have access to chalkboards or whiteboards in their room. Some campuses provide **pencils and notepads** to players. We recommend **inviting teams to bring additional supplies**, such as graph paper, colored pencils, and simple calculators.

Note that teams may also choose to bring laptops, cameras, and so on, and must provide their own **smart phones/devices** unless your campus provides them instead. We discourage campuses from banning the use of computers or the internet, since a phone can be used to perform the same tasks, but also do not suggest to explicitly recommend such items as they aren't required to enjoy or be competitive in this game. The puzzles are designed so that they generally cannot be solved using Google or brute force methods. (Savvy programmers might be able to write code to help optimize their team's Bonus Puzzle solution, which is why the Bonus Puzzle is essentially only used to break ties.)

## Copies

All puzzles are designed to be printed/copied in **grayscale**, both for the convenience of campuses and for accessibility by players. It is recommended to print copies for at least **two more teams than you expect to participate** as extras, depending on your access to last-minute copying.

You should have two separate PDFs: a complete **organizer book** that you're currently reading, and a **player book** to be distributed to players. We recommend printing **one organizer book per volunteer** in a binder, and **one stapled player book per player**.

## Check-in

**Each player** should receive their **player book**, or at least one book for every two players on a team. They should also receive a **pencil** and **notepad** for use during the game.

Teams' devices should be set up with the ClueKeeper app and Hunt Code (but not the Start Code). Some campuses have players use their own phones; other campuses provide iPads.

Some campuses also choose to distribute other giveaways/swag/brochures at registration. Many bookstores are willing to provide branded disposable bags to help distribute materials.

## Orientation

The **Rules** should be reviewed, and any questions from players should be answered. In particular, boundaries for where players are allowed to travel during the game should be established.

Once everyone is ready, present teams with the Start Code that will allow them to begin solving puzzles and start the game timer. Teams should be instructed to wait to enter it until they are settled in their HQ and ready to start solving.

## Gameplay

As clues are unlocked in ClueKeeper, players will be able to solve puzzles and input their solutions into ClueKeeper, earning points. Progress may be monitored at ClueKeeper.com.

Campuses using Cluekeeper's GPS will have players traveling to locations on campus to unlock Main Puzzles and Cryptic Puzzles. A campus map should be provided mapping the numbers 000 to 999 to various locations on campus (e.g. 000-049 is Building A, 050-099 is Building B, etc.). GPS enforcement can be turned off in case of rain, in which case the three digit code may be entered from any location. An example of this map for the University of South Alabama is included in this document; smaller campuses may use less locations.

A volunteer should stand at the door of Game Control to ensure at most one team is allowed in Game Control at all times, to avoid accidental spoiling of puzzle data between teams.

Recreational teams are allowed to ask for hints at Game Control at any time, and may be assisted by their sponsor. We encourage new teams who may not have a lot of math or puzzle experience to play recreationally. Recreational teams are not eligible for trophies or awards, or should be awarded separately from the competitive teams.

Competitive teams can ask for clarifications about the rules or how to use the ClueKeeper app, but generally they should not receive hints outside of those provided by ClueKeeper.

Each team is allowed three submissions of the Bonus Puzzle. Generally this puzzle should be judged by Game Control in front of the players to confirm the validity of the submission. Only the best submission from each team is used. If the game has ended with multiple teams in line for Game Control, all submissions for all teams should be collected as quickly as possible and graded. Teams may not submit multiple Bonus Puzzle solutions after the game has ended.

## **Food**

Campuses that will be running the event through lunchtime are encouraged to provide a **pizza lunch** for players. This lunch should not interrupt the game; rather, players should be able to grab a bite to eat to have while they continue to solve puzzles. In addition, **snacks** (fruit, granola bars, etc.) and **drinks** (bottled water) are nice for players to have access to during the game. Don't forget to provide appropriate **plates, cutlery, napkins, and trashbags**.

This food can be distributed at a **central location near Game Control** (but not inside Game Control's room where puzzles will be discussed).

## **Wrap-Up and Awards**

At the end of the game, teams should straighten up their classrooms before returning to Game Control for the Wrap-Up. **Trash bags** may be provided for this purpose.

Teams should line up outside Game Control until results have been tabulated. Once all results have been determined, teams may be seated inside Game Control.

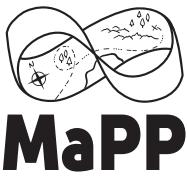
Solutions need not be reviewed together; instead, the full game book can be provided to teachers for follow-up/extension at a later date.

Awards for Recreational/Competitive teams are treated completely separately if both Leagues are present. **Certificates** should be distributed in random or alphabetical order to all teams placing below 3rd place. A **3rd Place Certificate/Trophy** is then awarded. After reminding the 1st place team to be respectful, a **2nd Place Certificate/Trophy** is then awarded, followed by the **1st Place Certificate/Trophy**. Opportunities for photographs should be allowed during this process and after dismissal.

After awards are done, teams may be dismissed.

## **Social Media**

Players/teachers/volunteers can be encouraged to tag @MaPPmath and #Challenge20 on Twitter with non-spoiler posts/media during and after the event. Everyone should be reminded that the game is played at multiple locations across the country, and we do not want to spoil future players on what's in store.



# MaPP Challenge '20 – Mindy Jonas and the Enigmatic Legacy

## How to Play

### Rules

## Leagues

Each team is registered in either the **Competitive or Recreational League**. If both Leagues are playing simultaneously today at your campus, then all scoring and awards are handled separately in both Leagues.

## Puzzle Packets and ClueKeeper

Each team has received multiple **Puzzle Packets**. However, there is not enough information in this packet to begin solving any puzzles.

Once the game begins, clues will become available in the **ClueKeeper** app that will allow players to begin solving puzzles in the packet. Once a puzzle is solved, its solution can be submitted via the app. As time progresses, hints for unsolved puzzles will unlock, helping teams who are stuck. The game ends when your time in ClueKeeper has expired.

## Main Puzzles

Once the game begins, you'll be presented with four **Main Puzzles**. Each Main Puzzle can be solved directly using mathematical modeling and problem-solving abilities. Once the solution for the puzzle has been entered into ClueKeeper, **1000 Victory Points** will be awarded, and the second part will be unlocked. This second part uses the first solution to extract a short word or phrase. Solving this second challenge is worth an additional **500 Victory Points**.

## Cryptic Puzzles

After solving the second part of each Main Puzzle, an additional **Cryptic Puzzle** will become available to solve. The way to solve these puzzles is left, well, cryptic. However, your team should still be able to use your critical thinking to extract a hidden word or phrase. Correct solutions are worth **500 Victory Points**.

## Bonus Puzzle

After solving all four Main Puzzles, the Bonus Puzzle will become unlocked in ClueKeeper. Your team will be asked to optimize a certain task, and present your solution to Game Control in person, which will be graded and awarded **up to 500 Victory Points**.

You may submit up to three solutions throughout the game (including any disqualified submissions), and your best solution of the three will be counted toward your score. You must bring a device with the ClueKeeper app with you to submit an answer; as long as your time has not expired when you arrive at Game Control, you will be able to submit your answer (even if you have to wait on other teams ahead of you first).

## Metapuzzle

Once your team has solved two Cryptic Puzzles, the final **Metapuzzle** becomes available, worth **1000 Victory Points**.

## Hints

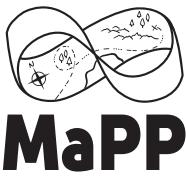
Recreational teams may ask for hints at Game Control at any time during the game, and may receive direct assistance from their teachers/chaperones as desired. Competitive teams may ask Game Control for rules clarifications or help with the ClueKeeper app (including help with entering solutions for the first part of a Main Puzzle), but otherwise will only receive help via hints made available in ClueKeeper.

## Winning the Game

The team that earns the **most Victory Points out of 10000** by the end of the game is the **winner**, with ties broken based on which team solved their final non-Bonus puzzle earliest.

## Additional Rules/Advice

- Players should not do anything which would interfere with other teams solving puzzles. Be a good sport!
- Submissions for each puzzle, besides the Bonus Puzzle, are unlimited. Every submission for the Bonus Puzzle will be carefully graded by Game Control, so only three submissions are allowed.
- Before visiting Game Control to ask for a hint or clarification, make sure you've read all the material accompanying the puzzle! Chances are, your question is covered there.
- Teachers and chaperones are not allowed to help Competitive teams solve puzzles.
- Teams may use any supplies they've brought and even look things up online to solve puzzles, but Competitive Teams may not receive any direct assistance from outside their team (e.g. you can't Phone a Friend).
- Players must remain within any physical boundaries set by both Game Control and their teacher/chaperone at all times, and must always travel with a teammate when leaving their headquarters.
- Teachers/chaperones are responsible for their students at all times.
- Since this game will be played at different campuses on different days, please do not spoil any of today's puzzles or solutions online until the game book is released publicly by MaPP!
- Contact Game Control immediately in the case of emergency or any issues with these rules.



# MaPP Challenge '20 – Mindy Jonas and the Enigmatic Legacy

## Game Resources

### Reference Sheet

Letter	Decimal	Binary	Morse	Braille	Letter	Decimal	Binary	Morse	Braille
A	1	00001	.-	⠄⠄	N	14	01110	-.	⠄⠄⠄⠄
B	2	00010	-...	⠄⠄⠄⠄	O	15	01111	---	⠄⠄⠄⠄⠄
C	3	00011	-.-.	⠄⠄⠄⠄⠄	P	16	10000	-.-.	⠄⠄⠄⠄⠄
D	4	00100	-..	⠄⠄⠄⠄⠄	Q	17	10001	--.-	⠄⠄⠄⠄⠄⠄
E	5	00101	.	⠄⠄⠄⠄⠄	R	18	10010	-.	⠄⠄⠄⠄⠄
F	6	00110	..-	⠄⠄⠄⠄⠄⠄	S	19	10011	...	⠄⠄⠄⠄⠄⠄
G	7	00111	--.	⠄⠄⠄⠄⠄⠄	T	20	10100	-	⠄⠄⠄⠄⠄⠄
H	8	01000	....	⠄⠄⠄⠄⠄⠄	U	21	10101	-.-	⠄⠄⠄⠄⠄⠄
I	9	01001	..	⠄⠄⠄⠄⠄⠄	V	22	10110	...-	⠄⠄⠄⠄⠄⠄⠄
J	10	01010	---.	⠄⠄⠄⠄⠄⠄⠄	W	23	10111	--.	⠄⠄⠄⠄⠄⠄⠄⠄
K	11	01011	-.-	⠄⠄⠄⠄⠄⠄⠄	X	24	11000	-..-	⠄⠄⠄⠄⠄⠄⠄⠄
L	12	01100	-..-	⠄⠄⠄⠄⠄⠄⠄	Y	25	11001	-.--	⠄⠄⠄⠄⠄⠄⠄⠄
M	13	01101	--	⠄⠄⠄⠄⠄⠄⠄	Z	26	11010	--..	⠄⠄⠄⠄⠄⠄⠄⠄⠄

#### Some famous numbers and lists

$\sqrt{2} \approx 1.41421\ 35623\ 73095\ 04880\ 16887\ 24209\ 69807\ 85696\ 71875\ 37694\ 80731\ 76679\ 73799\ 07324\ 78462\ 10703\ 88503\ 87534\ 32764\ 15727$

$e \approx 2.71828\ 18284\ 59045\ 23536\ 02874\ 71352\ 66249\ 77572\ 47093\ 69995\ 95749\ 66967\ 62772\ 40766\ 30353\ 54759\ 45713\ 82178\ 52516\ 64274$

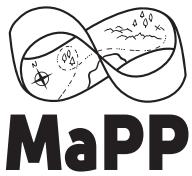
$\pi \approx 3.14159\ 26535\ 89793\ 23846\ 26433\ 83279\ 50288\ 41971\ 69399\ 37510\ 58209\ 74944\ 59230\ 78164\ 06286\ 20899\ 86280\ 34825\ 34211\ 70679$

Prime numbers less than 200:

2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97, 101, 103, 107, 109, 113, 127, 131, 137, 139, 149, 151, 157, 163, 167, 173, 179, 181, 191, 193, 197, 199

Square numbers less than 400:

0, 1, 4, 9, 16, 25, 36, 49, 64, 81, 100, 121, 144, 169, 196, 225, 256, 289, 324, 361



MaPP Challenge '20 – Mindy Jonas and the Enigmatic Legacy

# Game Resources

## Start Code

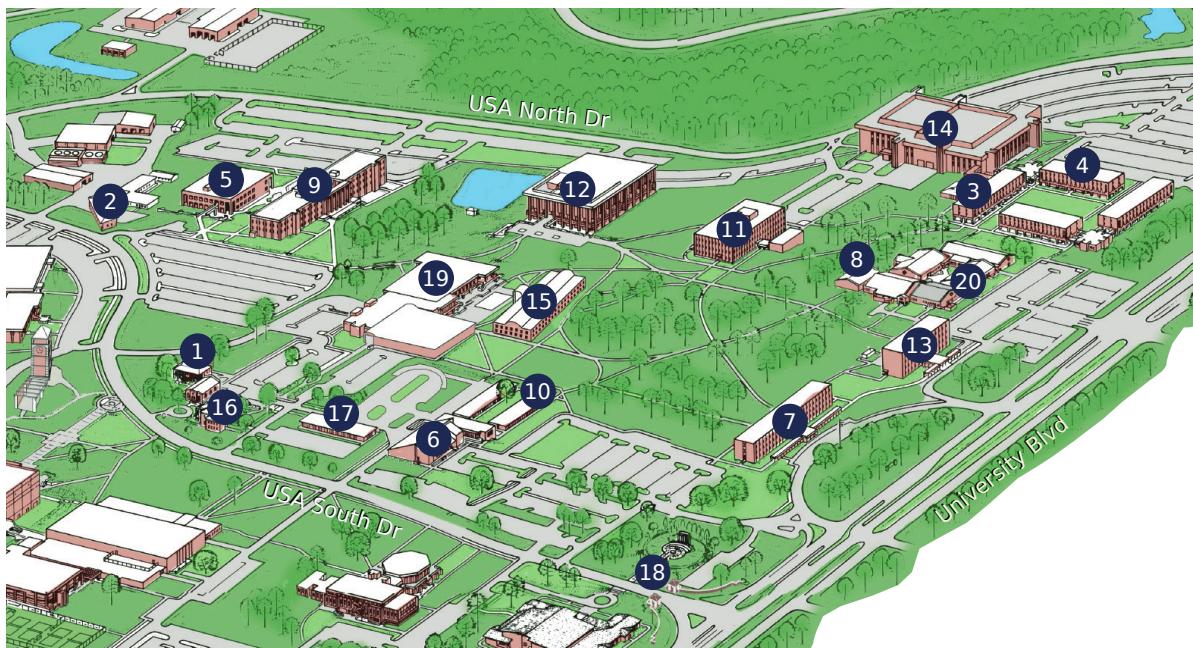
# MINDY



**MaPP**

## MaPP Challenge '20 – Mindy Jonas and the Enigmatic Legacy Game Resources

### Campus Map - University of South Alabama



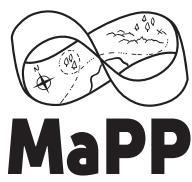
- |   |  |
|---|--|
| 1. Alumni Hall (Codes 000-049)                          | 11. Life Sciences Building (Codes 500-549)                     |
| 2. Archaeology Museum (Codes 050-099)                   | 12. Marx Library (Codes 550-599)                               |
| 3. Central Services Admin Building (Codes 100-149)      | 13. Mathematical Sciences and Physics Building (Codes 600-649) |
| 4. Charles M. Baugh Biomedical Library (Codes 150-199)  | 14. Medical Sciences Building (Codes 650-699)                  |
| 5. Chemistry Building (Codes 200-249)                   | 15. Meisler Hall (Codes 700-749)                               |
| 6. Computer Services Center (Codes 250-299)             | 16. Mobile Townhouse (Codes 750-799)                           |
| 7. F.P. Whiddon Administration Building (Codes 300-349) | 17. Student Health Center (Codes 800-849)                      |
| 8. Glass Arts Building (Codes 350-399)                  | 18. Tholos of Delphi Replica (Codes 850-899)                   |
| 9. Humanities Building (Codes 400-449)                  | 19. USA Student Center (Codes 900-949)                         |
| 10. Innovation in Learning Center (Codes 450-499)       | 20. Visual Arts Complex (Codes 950-999)                        |

To enter a Start Code that unlocks a Main Puzzle or Cryptic Puzzle, your device's GPS must detect that you are near the front door of the location corresponding to the code. For example, to enter the Start Code 123, you will need to visit Central Services Admin Building, since  $100 \leq 123 \leq 149$ .

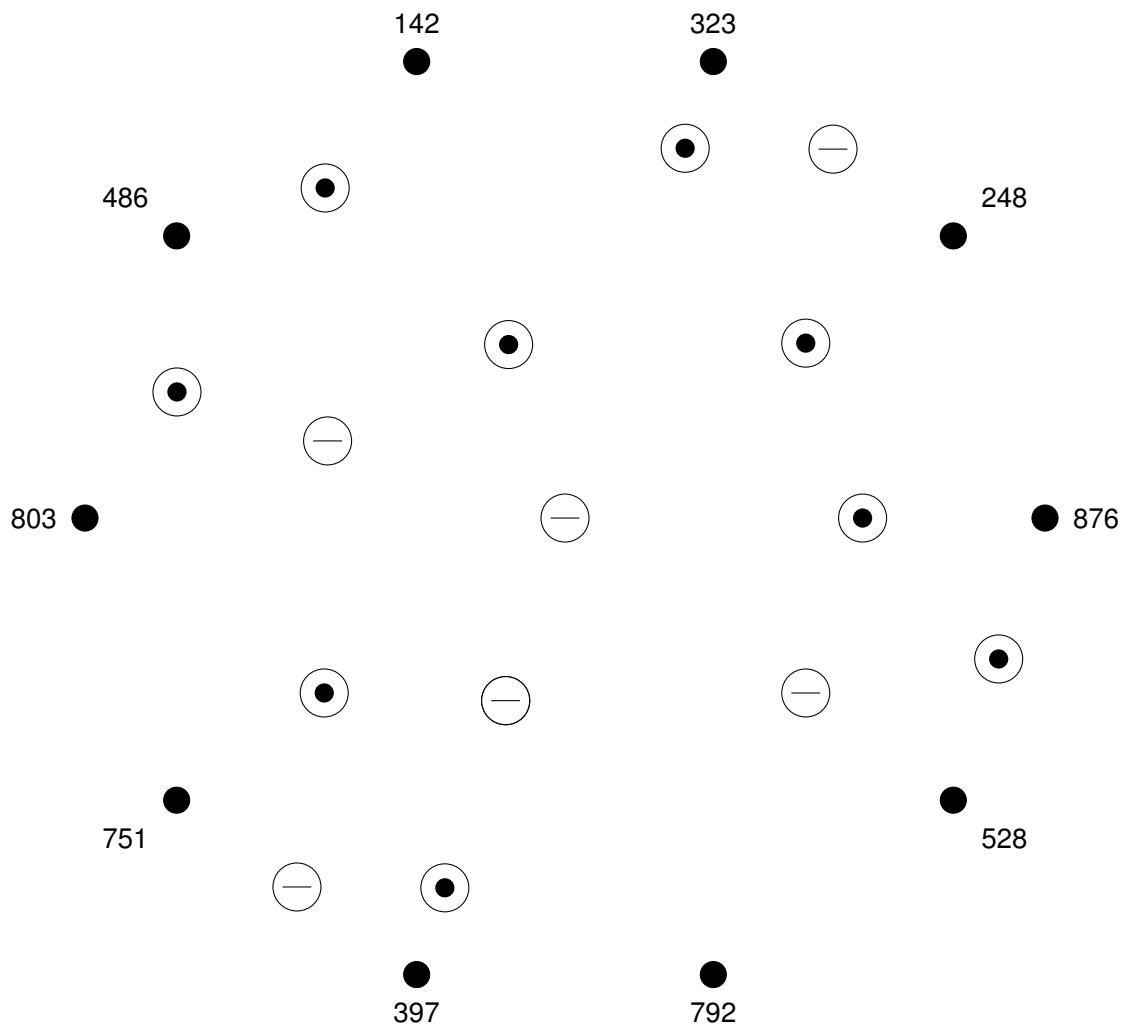
Players will not need to cross USA South Dr, USA North Dr, or University Blvd.

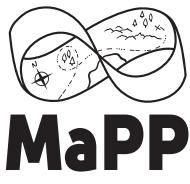
# **Part I**

# **Player Book**



MaPP Challenge '20 – Mindy Jonas and the Enigmatic Legacy  
**Dr. Jonas's Journal**  
January 20

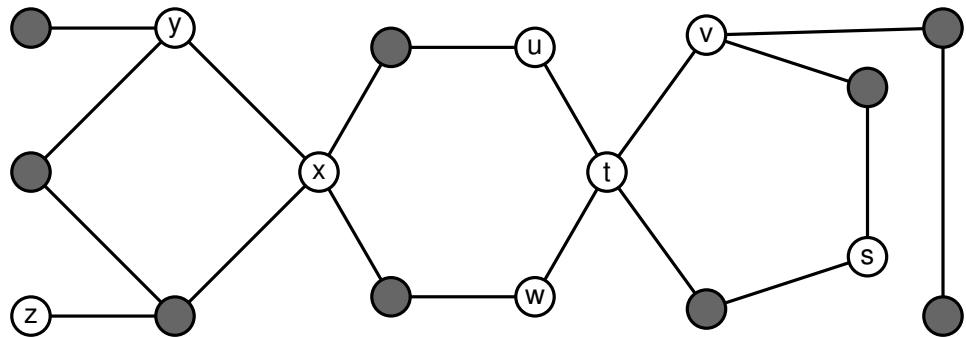
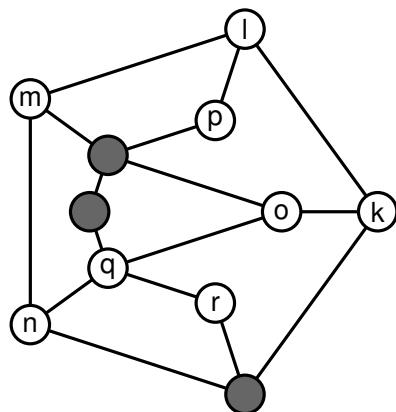
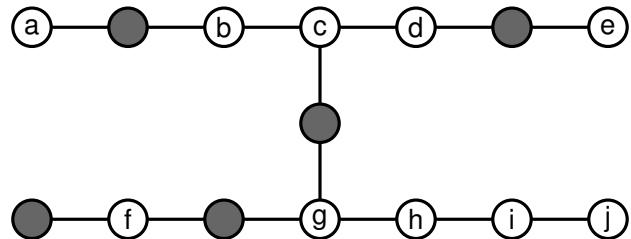




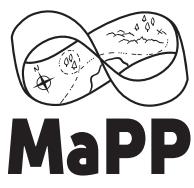
MaPP Challenge '20 – Mindy Jonas and the Enigmatic Legacy

# Dr. Jonas's Journal

## February 05



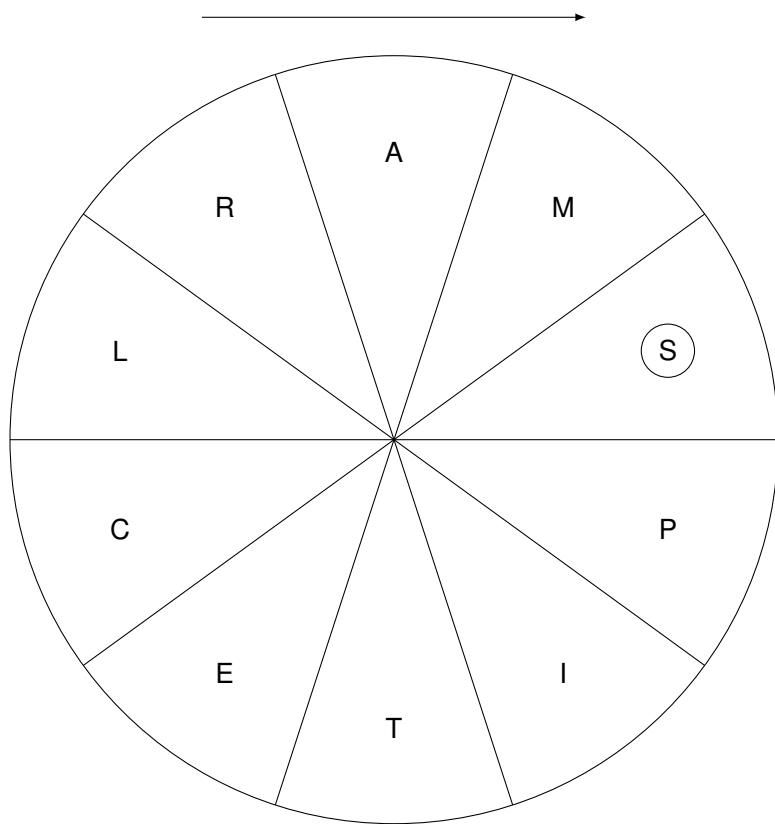
TOTAL BUDGET: \$12000

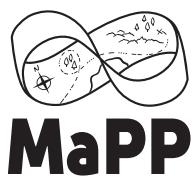


MaPP Challenge '20 – Mindy Jonas and the Enigmatic Legacy

# Dr. Jonas's Journal

March 16





MaPP Challenge '20 – Mindy Jonas and the Enigmatic Legacy

# Dr. Jonas's Journal

April 03

k u  
b p j  
f  
l h y  
n v  
z s o  
w x t  
a r g  
e c d  
q i m



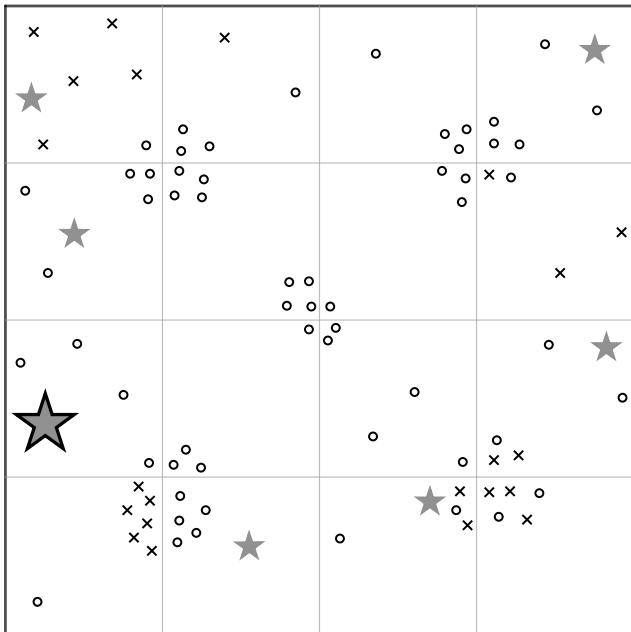
**MaPP**

MaPP Challenge '20 – Mindy Jonas and the Enigmatic Legacy

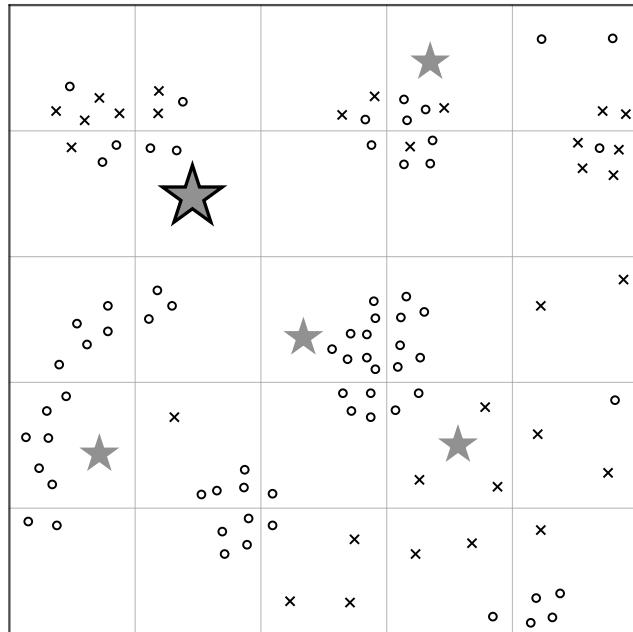
# Dr. Jonas's Journal

May 04

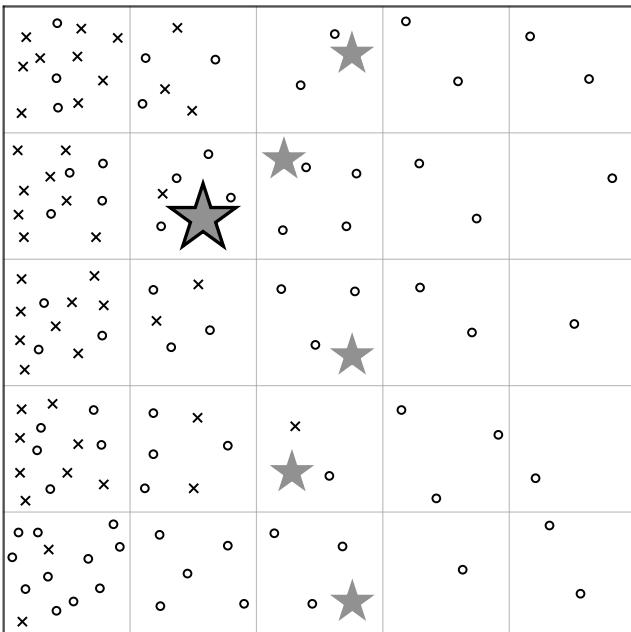
Tribe A



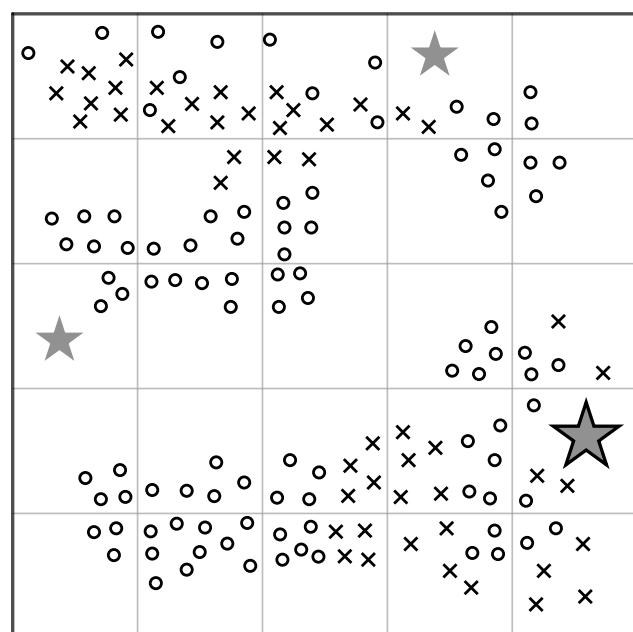
Tribe B



Tribe C



Tribe D





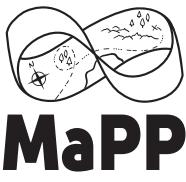
**MaPP**

MaPP Challenge '20 – Mindy Jonas and the Enigmatic Legacy

## Dr. Jonas's Journal

June 28

Journal	entry	June	28,	3513			
Succesful	dig	today.	We	found	a		
lot	of	pot	shards,	some	with	remarkably	
intact	artwork.	Like	in	the	tomb,	there	
are	scenes	of	men	with	circles	around	
their	heads,	looking	to	the	sky.	We	
believe	these	represent	past	kings,	deities,	or	
maybe	both.	I	recall	my	advisor's	words,	
"people	are	not	pots."	I	should	be	
careful	before	drawing	any	firm	conclusions.	On	
the	other	end	of	the	site	from	
the	tomb	we	found	a	burial	site.	
It	was	lined	with	red	ochre,	the	
bodies	were	facing	east	with	their	arms	
folded.	Already	this	site	has	yielded	so	
much.	If	only	the	university	understood.	They	
want	to	save	money	so	badly,	but	
what	is	it	for	if	not	this?	



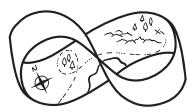
MaPP Challenge '20 – Mindy Jonas and the Enigmatic Legacy

# Dr. Jonas's Journal

## July 21

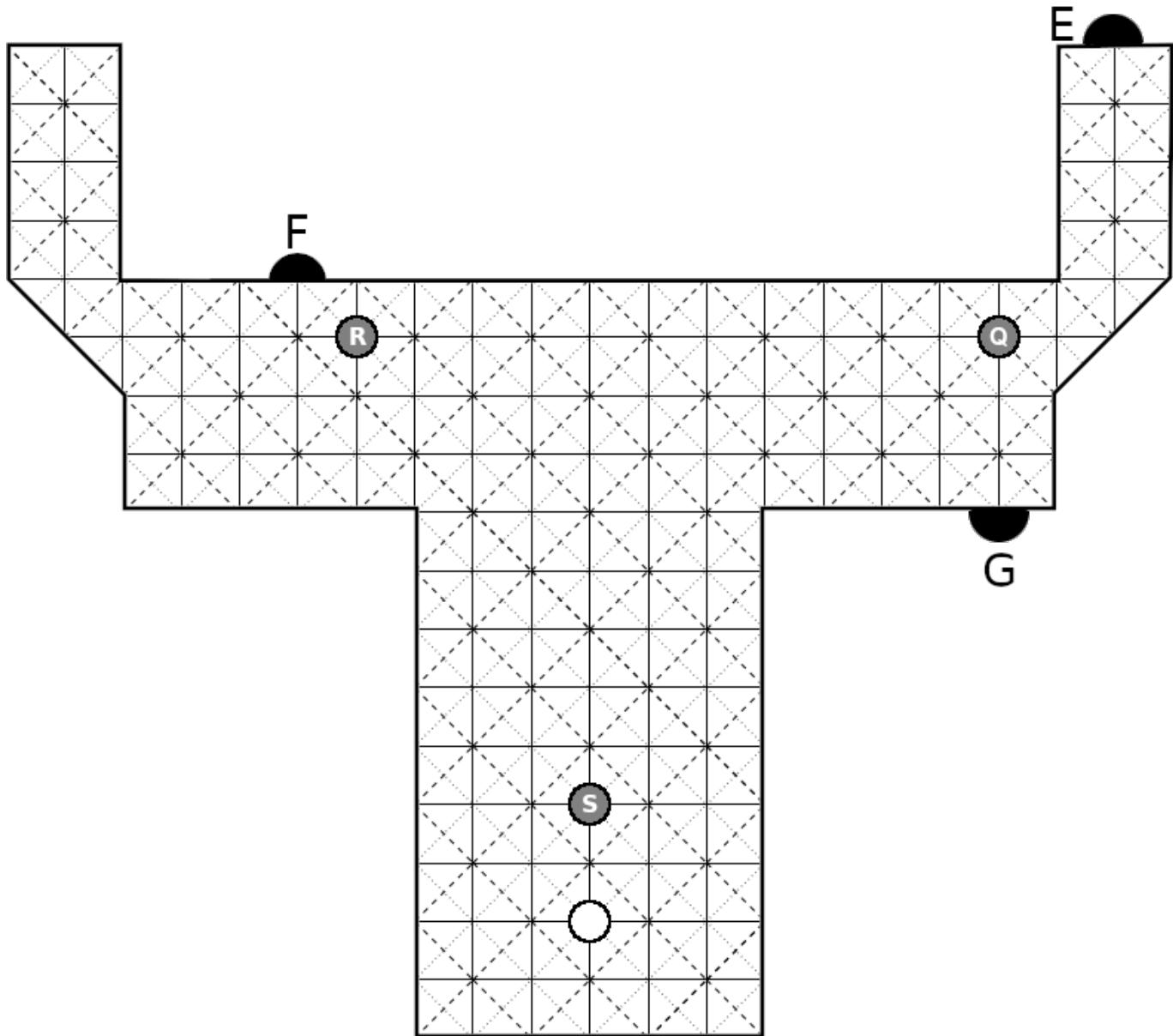
Budgeting and begging for grants isn't the most exciting aspect of archaeology, but I suppose it's a necessary evil.

Topic	Detail	Budget Code	Cost
Field work salary	Dr. M. Jonas	N	\$12,717
Field work salary	B. Fraiser	P	\$1,982
Travel expenditures	Lodging	F	\$3,291
Excavation	Digging equipment	Q	\$20,183
Excavation	Artifact cleaning and cataloging	A	\$8,215
Research	Osteology consultant	C	\$6,499
Research	Ceramic analysis	Q	\$7,211
Research	Floral analysis	K	\$5,525
Research	Faunal analysis	Q	\$5,527



**MaPP**

MaPP Challenge '20 – Mindy Jonas and the Enigmatic Legacy  
**Dr. Jonas's Journal**  
August 09



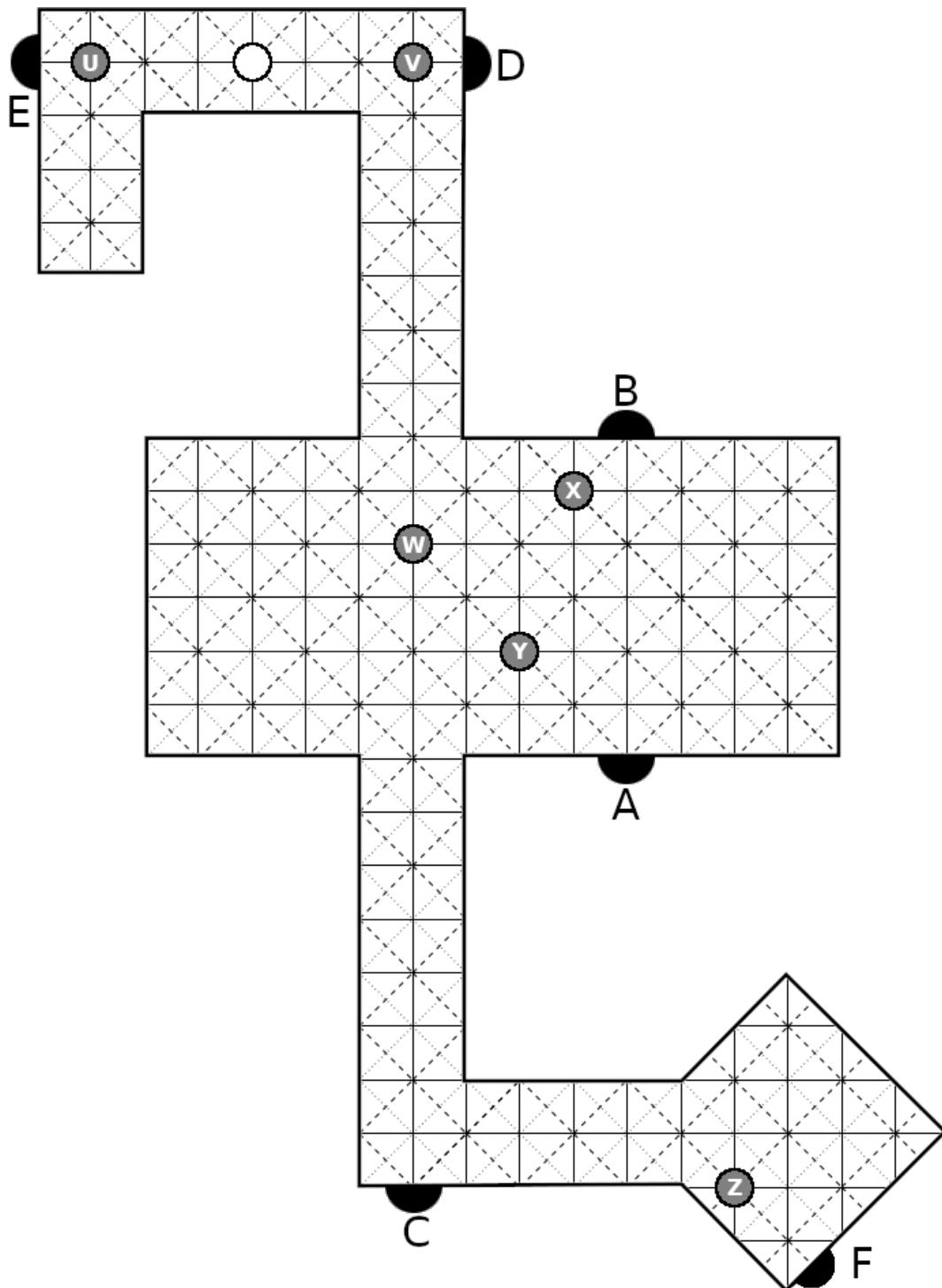


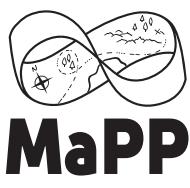
**MaPP**

MaPP Challenge '20 – Mindy Jonas and the Enigmatic Legacy

# Dr. Jonas's Journal

August 10

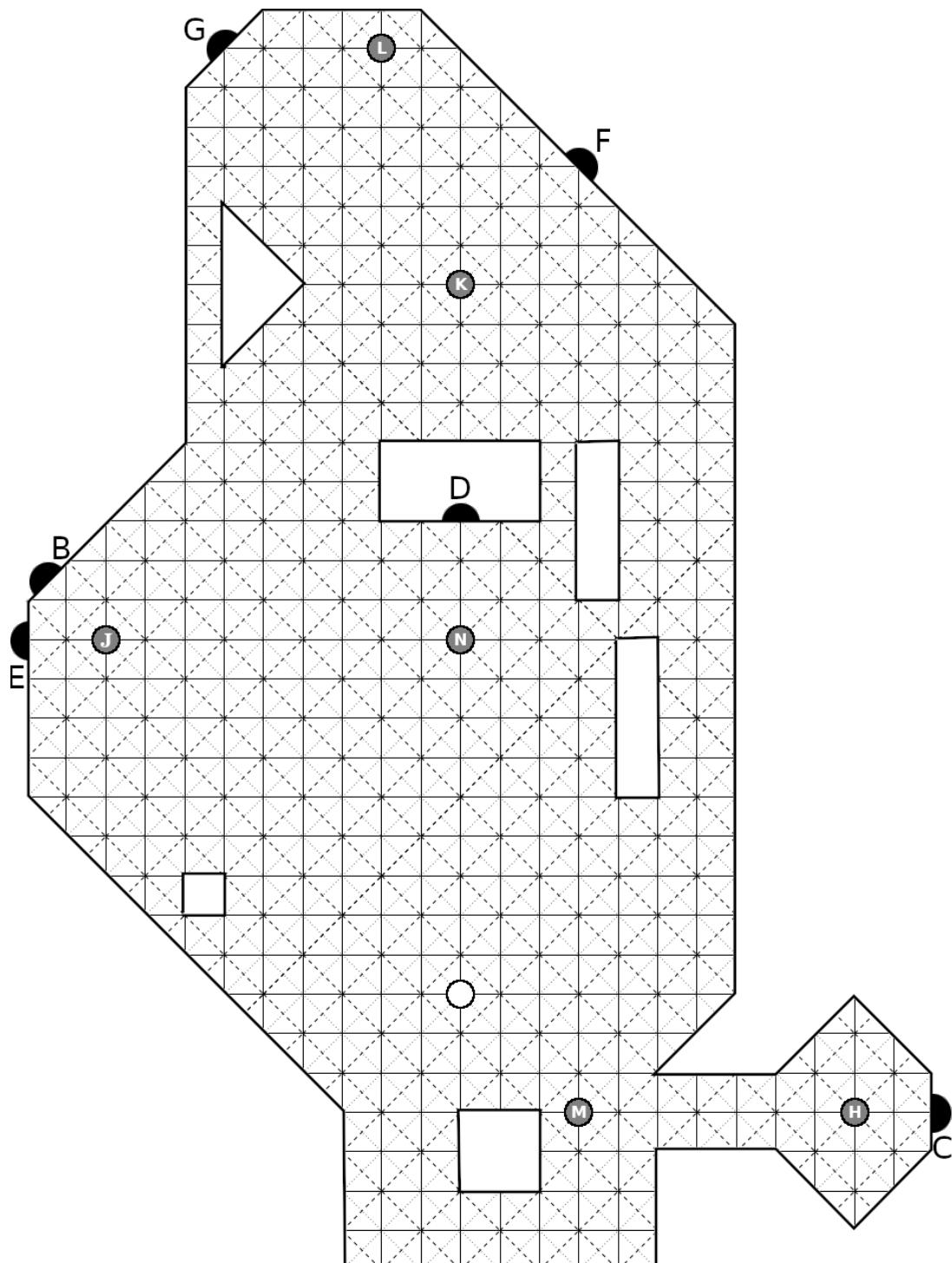


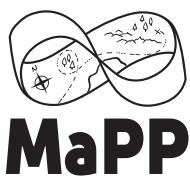


MaPP Challenge '20 – Mindy Jonas and the Enigmatic Legacy

# Dr. Jonas's Journal

August 11

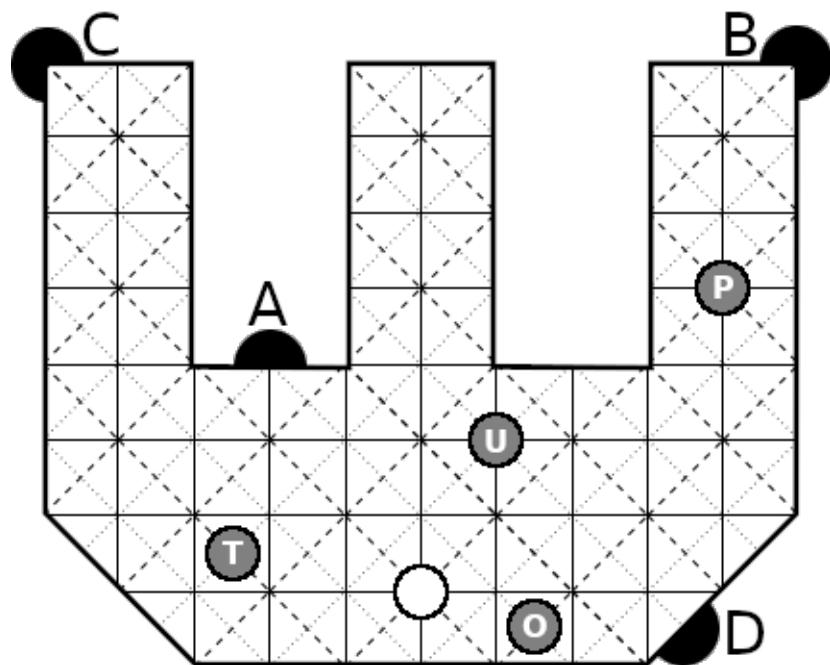


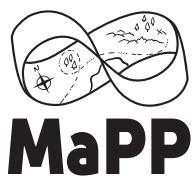


MaPP Challenge '20 – Mindy Jonas and the Enigmatic Legacy

## Dr. Jonas's Journal

August 12

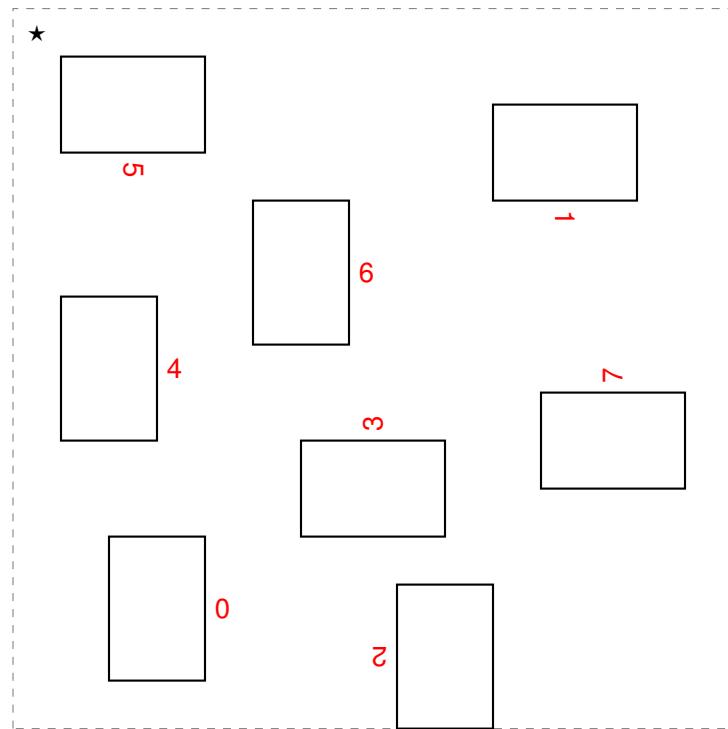
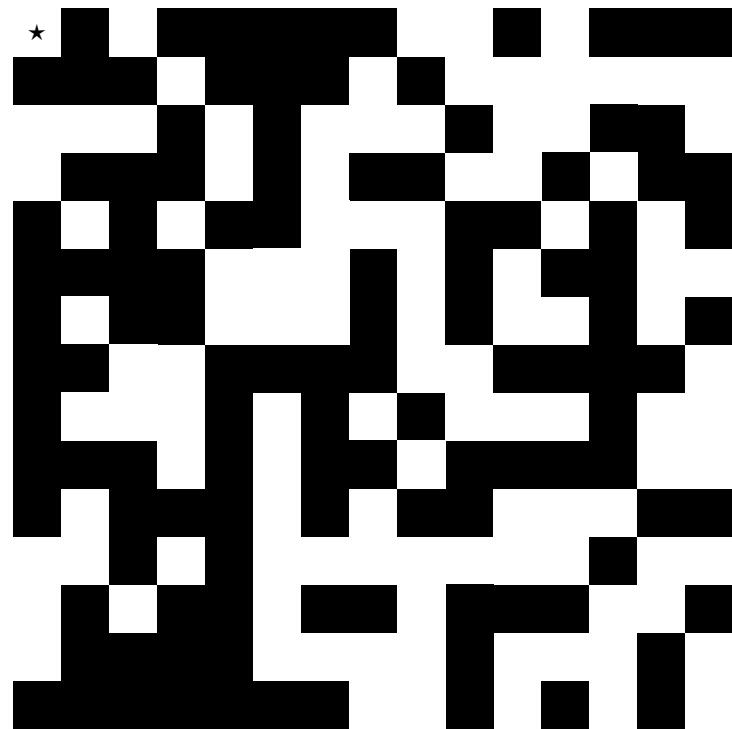


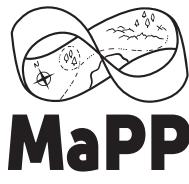


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# Dr. Jonas's Journal

September 18

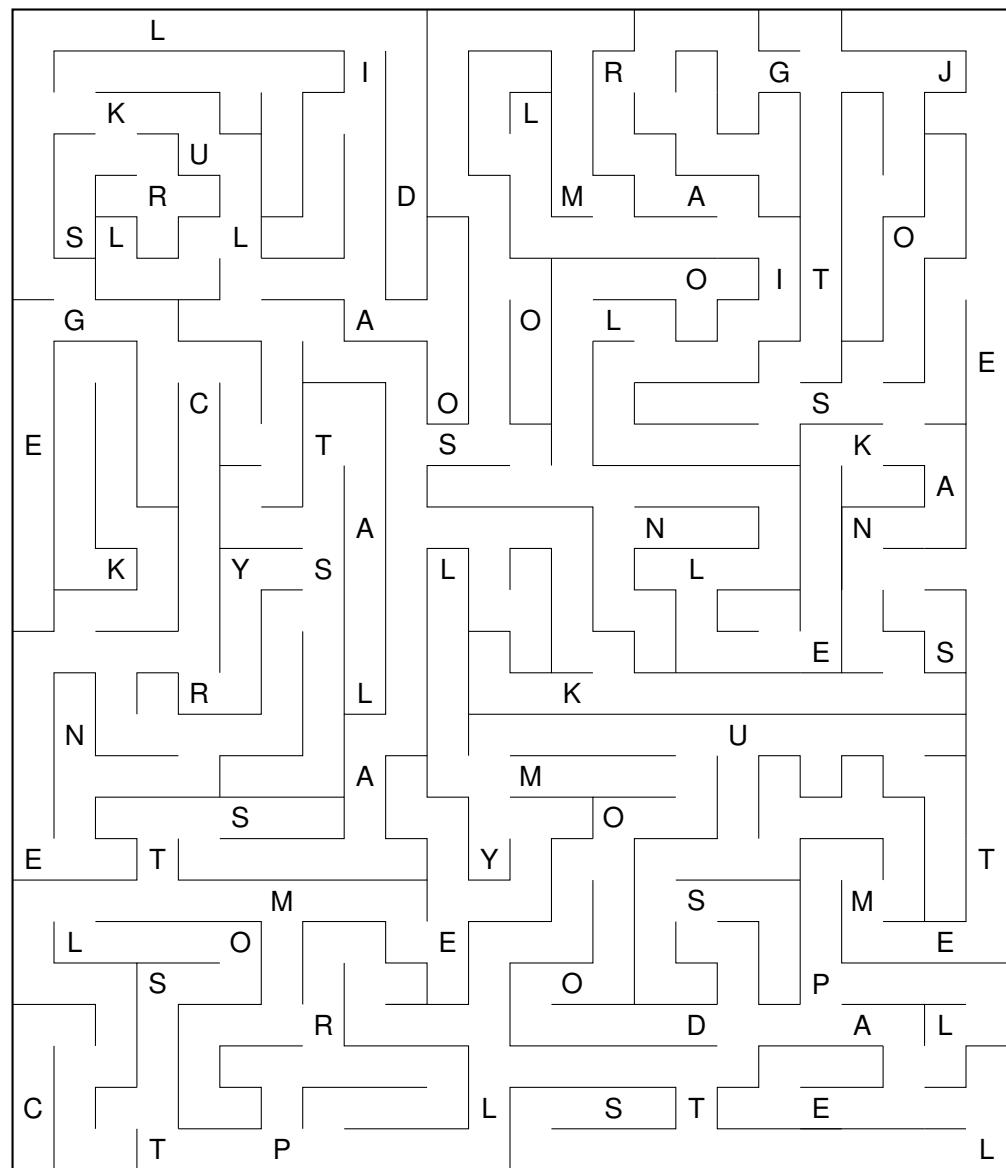


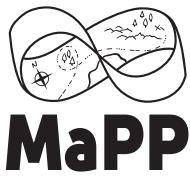


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## Dr. Jonas's Journal

October 22





MaPP Challenge '20 – Mindy Jonas and the Enigmatic Legacy

# Dr. Jonas's Journal

November 01

Village market:

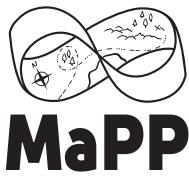
1. M to 2A and L?
2. 2A to 2L?
3. A to 3A and M?
4. A to 3A?
5. A to L?

Market square:

1. 2T to 3F and 3Q?
2. T to 50T?
3. T to T and F?
4. T to Q?
5. T to 3T?

Black market:

1. S to 2S?
2. 2S to S and 2B?
3. 3S to 3C?
4. S to B and 2C?
5. 4S to 2S, 2B, and 5C?



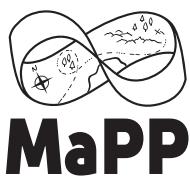
MaPP Challenge '20 – Mindy Jonas and the Enigmatic Legacy

## Dr. Jonas's Journal

December 25

- ❖ What A Splendid Day! Ever Since Champollion
- ❖ Discovered The Wall Paintings In The Third
- ❖ Dynasty Tomb, We've Known That Like Other
- ❖ Ancient Peoples, The Fregians Had A Ball
- ❖ Game, Yet No Arenas Or Equipment Had
- ❖ Ever Been Found. That Changed Today. I
- ❖ Have Very High Confidence That The Ruins
- ❖ We Discovered Are Indeed The Remains Of
- ❖ One Of These Ancient Collusiums. While Everyone
- ❖ Thought That The Wall Paintings Were Exaggerated,
- ❖ Boulders Over Five Meters In Diameter Were
- ❖ Used In This Sacred Game! How Fascinating!



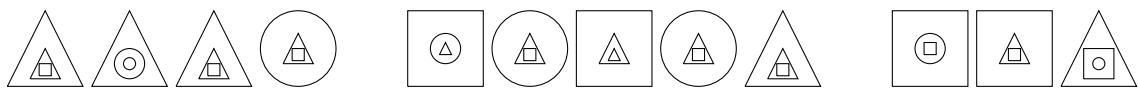


MaPP Challenge '20 – Mindy Jonas and the Enigmatic Legacy

# Dr. Jonas's Journal

## Undated Entry #1

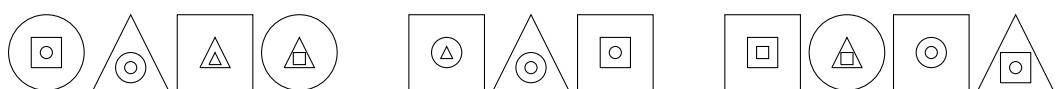
First



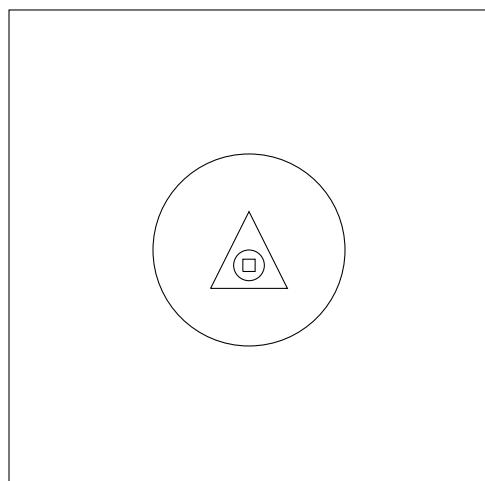
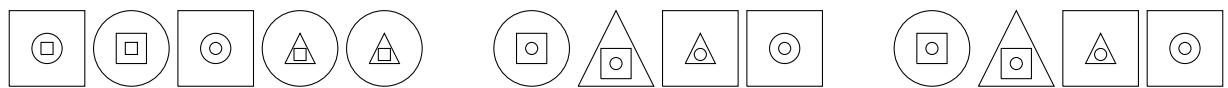
Second

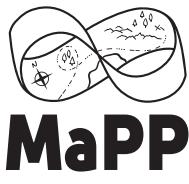


Third



Fourth

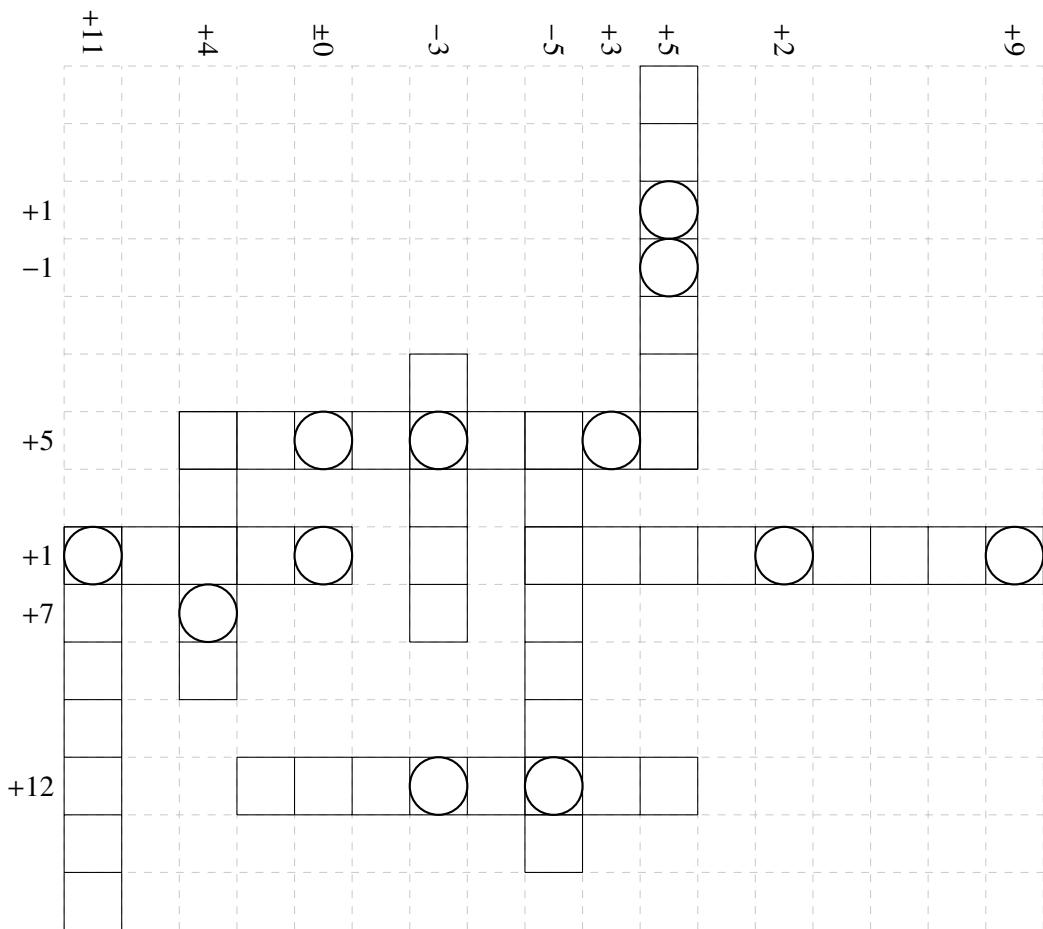




MaPP Challenge '20 – Mindy Jonas and the Enigmatic Legacy

# Dr. Jonas's Journal

## Undated Entry #2



GREEK

SCHOLAR

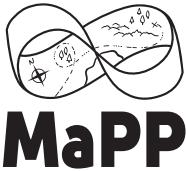
POLYMATH

INVENTOR

GEOGRAPHY

## **Part II**

# **ClueKeeper Info**



## MaPP Challenge '20 – Mindy Jonas and the Enigmatic Legacy **Location Puzzles**

### **Main Puzzle 1**

In Dr. Jonas's journal, a strange code is used in Undated Entry #1. I'm pretty confident each word represents one of the English words for the digits ZERO through NINE.

Decipher the 1st three-digit number, and head to the corresponding location on your campus map. Enter that number into ClueKeeper, and if your GPS is in the correct location, I'll be able to unlock your first Main Puzzle.  
-BF

### **Main Puzzle 2**

In Dr. Jonas's journal, a strange code is used in Undated Entry #1. I'm pretty confident each word represents one of the English words for the digits ZERO through NINE.

Decipher the 2nd three-digit number, and head to the corresponding location on your campus map. Enter that number into ClueKeeper, and if your GPS is in the correct location, I'll be able to unlock your second Main Puzzle. -BF

### **Main Puzzle 3**

In Dr. Jonas's journal, a strange code is used in Undated Entry #1. I'm pretty confident each word represents one of the English words for the digits ZERO through NINE.

Decipher the 3rd three-digit number, and head to the corresponding location on your campus map. Enter that number into ClueKeeper, and if your GPS is in the correct location, I'll be able to unlock your third Main Puzzle. -BF

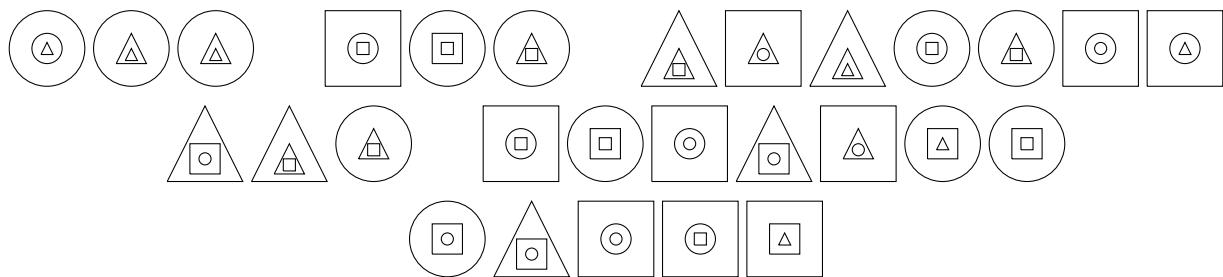
### **Main Puzzle 4**

In Dr. Jonas's journal, a strange code is used in Undated Entry #1. I'm pretty confident each word represents one of the English words for the digits ZERO through NINE.

Decipher the 4th three-digit number, and head to the corresponding location on your campus map. Enter that number into ClueKeeper, and if your GPS is in the correct location, I'll be able to unlock your fourth Main Puzzle. -BF

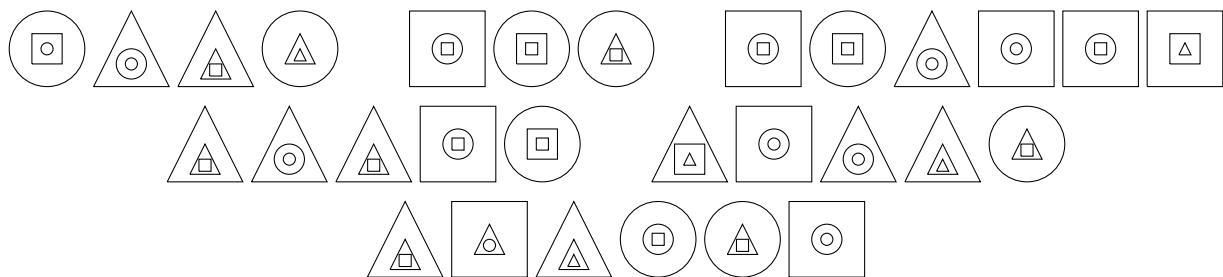
## Cryptic Puzzle 1

I have an update on another puzzle - can you figure out the three-digit number given by this clue? Head to the location corresponding to it on your campus map and enter it into ClueKeeper to unlock it! -BF



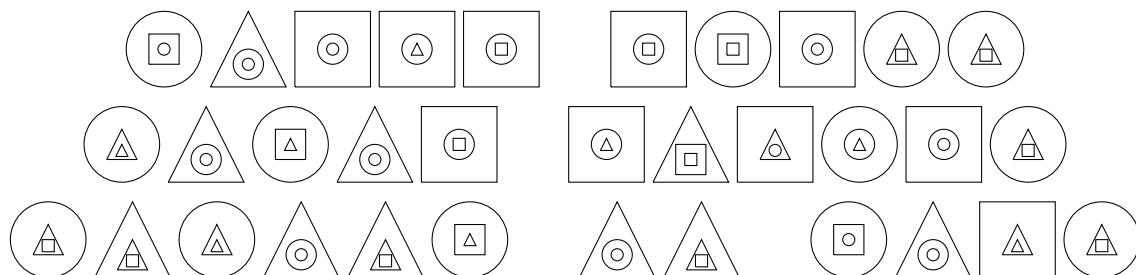
## Cryptic Puzzle 2

I have an update on another puzzle. Head to the location on your campus map corresponding to the three-digit number given by this clue and enter it into ClueKeeper to unlock it! -BF



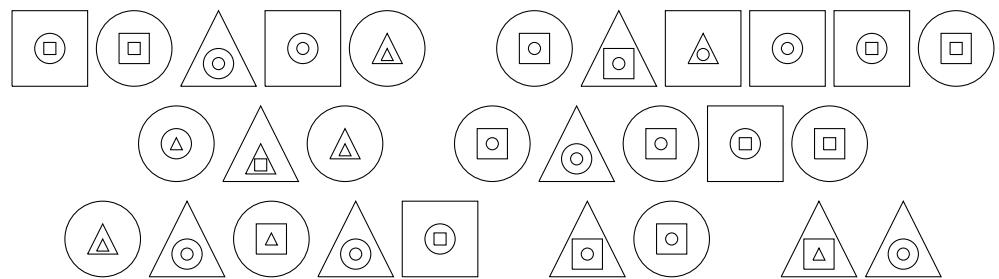
## Cryptic Puzzle 3

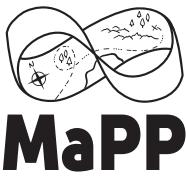
I have an update on another puzzle. Head to the location on your campus map corresponding to the three-digit number given by this clue and enter it into ClueKeeper to unlock it! -BF



## Cryptic Puzzle 4

I have an update on another puzzle. Head to the location on your campus map corresponding to the three-digit number given by this clue and enter it into ClueKeeper to unlock it! -BF





MaPP Challenge '20 – Mindy Jonas and the Enigmatic Legacy

## Main Puzzle 1

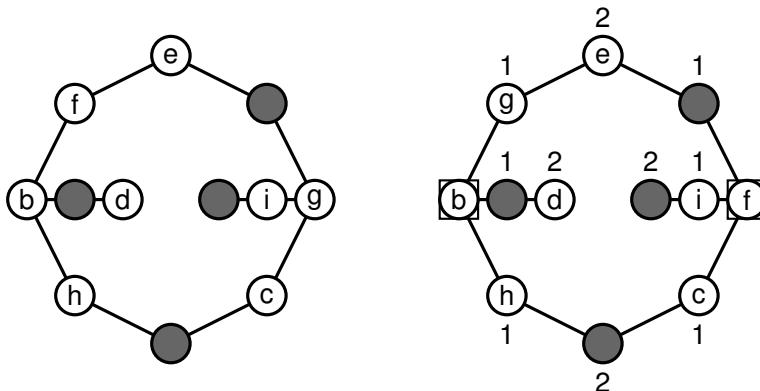
### Searching the Tombs

The necropolis of Ramsey is a complex of underground mausoleums, buried by earth and time. It is also where Dr. Jonas almost got fired. It seems that these mausoleums were cursed, guaranteeing that the room containing hidden artifacts would always be as far away from her excavation team as possible, wasting university resources.

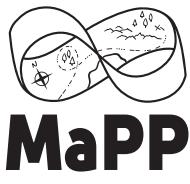
To solve this problem, she made the following plan. To explore a mausoleum, she would send one or more research assistants into accessible rooms, each costing \$1000 in funds. Then using advanced artifact-finding technology, she could pinpoint the location of the hidden artifacts, and one of the closest assistants could then travel to that room (which is always as far away as possible, and might require traveling through rooms inaccessible from the surface) and extract the goods, costing another \$1000 per room explored.

I've attached an example of such a plan to this message. Each labeled circle is a room of the mausoleum accessible from the surface, and each gray circle is inaccessible from the surface. There is a unique way to place assistants in the accessible rooms to minimize the total cost of exploring this mausoleum to \$4000, which I've marked with squares.

I have a feeling that Dr. Jonas's February entry contains three of these mausoleum diagrams. Can you identify where to place assistants in each to minimize the total cost of all three crypts? Answer using ClueKeeper by listing all letters used in alphabetical order. -BF



$$\begin{array}{r} \text{2 people for \$2000} \\ +2 \text{ extra rooms for \$2000} \\ \hline \text{total cost \$4000} \end{array}$$



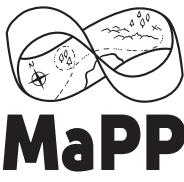
MaPP Challenge '20 – Mindy Jonas and the Enigmatic Legacy

## Main Puzzle 1

### Searching the Tombs - Part 2

Nice job! It looks like rooms cgovx should be used to minimize the total cost of the excavation.

I'm wondering if these letters are the secret to understanding Dr. Jonas's April entry. Perhaps a secret word may be somehow found within those five letters? -BF



MaPP Challenge '20 – Mindy Jonas and the Enigmatic Legacy

## Main Puzzle 2

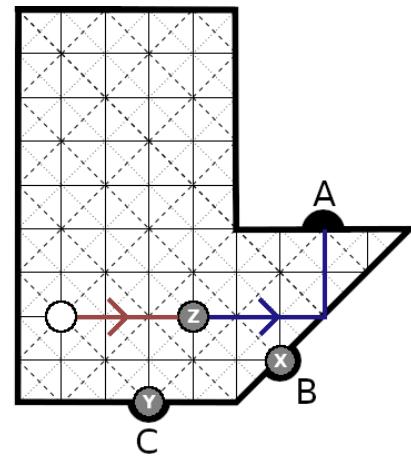
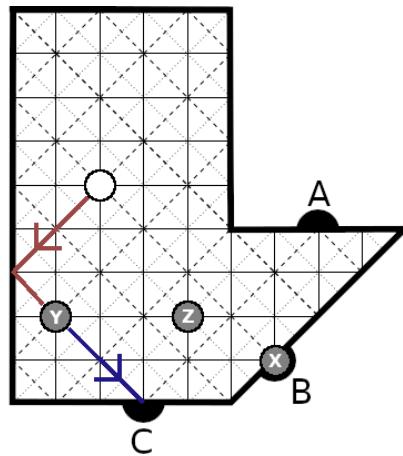
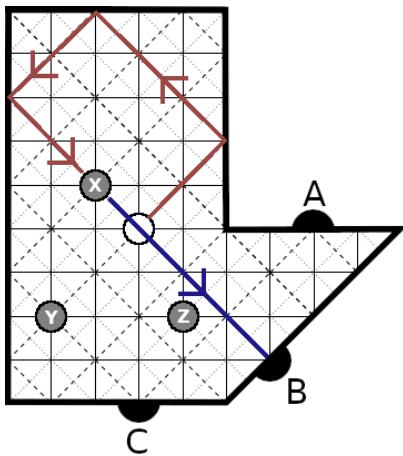
### The Fox and the Rabbits

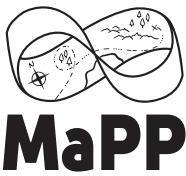
Dr. Mindy Jonas' first major discovery was the remarkable boulder game of the Fregian people. The Fregian kings built massive arenas with a fantastic variety of shapes and sizes. After surviving her own harrowing encounter with a boulder in a long-lost temple, Dr. Jonas found an ancient tablet describing the rules to this game.

- The game was played with two kinds of boulders: a white one called the fox and several darker ones, called the rabbits.
- The goal of the game was for the fox boulder to hit the rabbit boulders into the holes at the edge of the arena. Exactly one rabbit boulder would be hit into each hole.
- The fox boulder could only be launched along the marked vertical, horizontal, and diagonal trajectories. When it collided with a rabbit boulder, the fox boulder would take the place of the rabbit and the rabbit would continue in the direction it was hit.
- The rabbit boulders were not allowed to strike each other, and no boulder was allowed to hit a sharp corner in the arena.
- Once moving, a boulder would continue to move around the arena indefinitely, bouncing off walls until it struck another boulder or sank into a hole.

I believe the August entries in Jonas's journal are records of five such arenas, and there is a unique way to win each game. I've attached an example arena below to show you what I mean.

Can you solve the four arenas in her journal by entering how each boulder and hole matches up into Clue-Keeper? Use the format zB-yC-xA, making sure to keep the same order as the boulders are used in each puzzle. -BF





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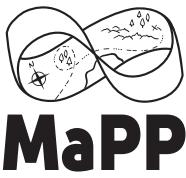
## Main Puzzle 2

### The Fox and the Rabbits - Part 2

Good work finding all four solutions:

- Arena 1: sG-rF-qE
- Arena 2: uE-vD-wC-xB-yA-zF
- Arena 3: nD-jE-kF-IG-mB-hC
- Arena 4: tC-uD-oA-pB

Looking at the June journal entry, I can't help but notice the strange year used: 3513. Here's an idea: label the columns of this entry with the letters A through G, and the rows h through z. Then maybe you can use the arena solutions and the number 3513 to extract a hidden four-word phrase? -BF



## MaPP Challenge '20 – Mindy Jonas and the Enigmatic Legacy

# Main Puzzle 3

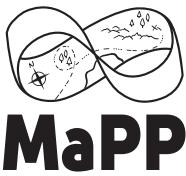
## Bazaar Trades

The Skolem people of Mesopotamia had many myths and legends. Dr. Jonas was particularly interested in the story of Queen Noether, famed for her ability to barter with traders and merchants. Legend has it, she had no trouble making some fantastic trades. Even if some seem like bad deals, Noether could make any of the following trades, and their opposite trades as well.

- One apple for one piece of meat:  $A \leftrightarrow M$
- One bottle for one magic crystal and one spice bag:  $B \leftrightarrow C + S$
- One magic crystal for two magic crystals:  $C \leftrightarrow 2C$
- One flag for one flag and one tapestry:  $F \leftrightarrow F + T$
- One loaf of bread for one apple and one piece of meat:  $L \leftrightarrow A + M$
- One piece of meat for one apple, one loaf of bread, and one piece of meat:  $M \leftrightarrow A + L + M$
- One quilt for one quilt and one tapestry:  $Q \leftrightarrow Q + T$
- One spice bag for one bottle:  $S \leftrightarrow B$
- One tapestry for one flag and one quilt:  $T \leftrightarrow F + Q$

Despite this, even Noether had her limits. Sure, she could certainly exchange two bottles for two spice bags and two magic crystals, since  $B + B \rightarrow B + C + S \rightarrow S + S + C \rightarrow S + S + C + C$ . But there's no way she could exchange one spice bag for two bottles by using those trades alone.

I think Dr. Jonas was investigating these limits in the November entry of her journal. For each of the three markets, decide if each trade is possible (P) or impossible (I). Submit your solution to ClueKeeper using the format PIPIP for each market. -BF



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## Main Puzzle 3

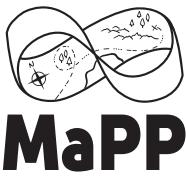
### Bazaar Trades - Part 2

Nicely done! You figured out which of the trades were possible (P) or impossible (I) for each market. What if we organize that information like this, letting  $P = 1$  and  $I = 0$ :

	Village M.	M. Square	Black M.	Binary
#1	P	P	I	110
#2	I	P	I	
#3	P	I	I	
#4	I	I	P	
#5	I	P	P	

Each binary number with three digits is equal to a number between 0 and 7, and those are the exact numbers found in the September journal entry. That's not a QR code - it's another hidden message from Dr. Jonas!

I'll leave it to you to figure out how to use the five numbers from the chart above to solve the September puzzle, but I have a feeling that binary isn't the only code involved here...



## MaPP Challenge '20 – Mindy Jonas and the Enigmatic Legacy

# Main Puzzle 4

### Ancient Gerrymandering

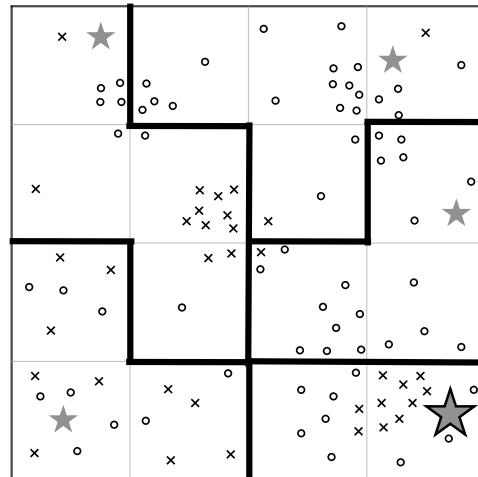
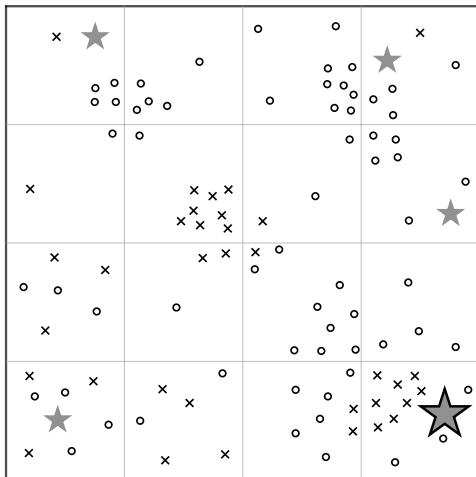
One of Dr. Jonas' greatest discoveries was the democratic nation of Heyting people, who kept meticulous records of their elections and their rulers. Strangely, even though the Heyting people were democratic, their voting records indicated that many of their elected officials often received less than the majority of the votes. How could this happen?

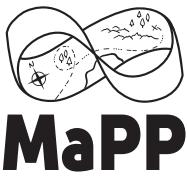
Well, to simplify the voting process, each of the Heyting tribes had broken their land up into districts. Each district had one vote for the next ruler of that tribe, which was based upon the majority vote from within the district. However, since the existing tribe leaders were allowed to draw the boundaries of the districts themselves, as long as they respected the following guidelines, the minority party X was able to keep power from the majority party O.

1. Each district had to be a single connected region.
2. Each district needed to contain a single temple (marked as stars on the maps).
3. The difference in population between any two districts had to be 5 or less.
4. All district boundary lines had to follow the horizontal and vertical grid lines provided.

For each of the four tribes, find a way to draw the district lines such that party X has strictly more votes than party O in more than half of the total districts. Then enter the total population (Xs and Os) for each of the capital districts (containing the biggest star) into ClueKeeper using the following format: A##-B##-C##-D##.

I'm attaching an example Tribe Z. Note that its solution would be entered into ClueKeeper as Z19 since the capital district has 19 people. -BF





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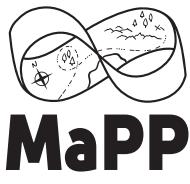
## Main Puzzle 4

### Ancient Gerrymandering - Part 2

Amazing!

It seems that the numbers 11, 17, 17, 49 must be the key to understanding one of Dr. Jonas's journal entries.

Say, what about that weird wheel she drew in March? Can you use those numbers to somehow spell out a five-letter word? I'd start with the circled S... -BF



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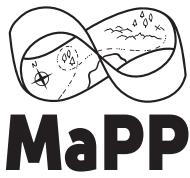
# Cryptic Puzzle 1

## A Timely Text

Okay, this is weird. I just received the following text from Dr. Jonas's phone!

*i must be out of my SKULL. i thought that i had LOST it in October, back at that TEMPLE. that SNAKE must have found the CRYSTAL. this truly is my holy GRAIL. i'll follow it to my DOOM.*

Frankly, it seems like nonsense, but maybe it's the clue to understanding another journal entry? -BF



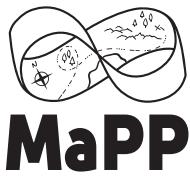
MaPP Challenge '20 – Mindy Jonas and the Enigmatic Legacy

## Cryptic Puzzle 2

### Dressed to the Nines

Dr. Jonas would often tell me that the mathematicians of the early Fregian society had a special interest in the number 9. Since they also used our base-ten counting system, they knew of an easy way to discover if a number was divisible by 9: just add up the digits! If that smaller number is divisible by 9, so is the original.

Come to think of it, I remember Dr. Jonas saying once that the Fregians would often try to find pairs of numbers that summed to a multiple of nine. She said something about how it helped them “connect the dots”. If only that could help us understand her journal a little bit better. -BF



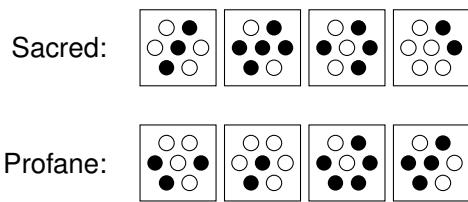
## MaPP Challenge '20 – Mindy Jonas and the Enigmatic Legacy

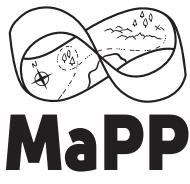
# Cryptic Puzzle 3

### Simon Says

Shortly before she disappeared, Dr. Jonas was obsessed with studying the designs found on the dice used by the ancient Heyting people. It seems that between one and seven pips would be handcarved into the sides of a cube. While the position of the pips wouldn't affect the value of the roll (two pips always has a value of 2, no matter how they are arranged), some pip designs were considered sacred, while the rest were known as profane.

I don't know the rules for what makes a pip design sacred or not, but I've attached some examples from Dr. Jonas's notes. Maybe they'll be of some use in understanding one of her journal entries. -BF





## MaPP Challenge '20 – Mindy Jonas and the Enigmatic Legacy

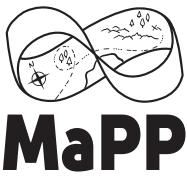
# Cryptic Puzzle 4

### It All Adds Up

Maybe it's nothing, but looking through my emails from Dr. Jonas, this one stuck out to me in particular as being possibly related to her journal... -BF

*Great news, we got funded! I put in requests to three different funding agencies, and they each agreed to cover the exact cost of three expenses from our budget.*

Funding Agency	Amount	Budget Code Adjustment
National Science Foundation	\$36,191	-5
National Endowment for the Humanities	\$14,006	-2
Archaeological Institute of America	\$20,953	+1

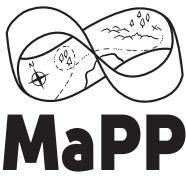


## MaPP Challenge '20 – Mindy Jonas and the Enigmatic Legacy **Metapuzzle** Let's Find the Professor!

Team, I'm so sorry. I was too afraid to trust you before, but after seeing how many puzzles you've solved, I think I can finally tell you the truth.

In a stunning twist none of you expected, I'm convinced that Dr. Jonas has been abducted by extraterrestrials! I have a final message from her on my computer, but of course it's encrypted by a 12-letter keyword. The only clue I have from her is this: "Use the four secret words found in my particularly cryptic journal entries to solve my final puzzle."

I'm begging you, please help me figure out this keyword so we can finally solve the mystery of our missing professor! -BF



# MaPP Challenge '20 – Mindy Jonas and the Enigmatic Legacy

## Bonus Puzzle

### The Golden Deck

Holding dual math and archaeology PhDs, Dr. Jonas was very interested in the mathematics and numerology of the ancient Fregian people. According to their traditions, the following numbers were considered “golden”:

10946    17711    28657    46368    75025    121393    196418    317811    514229    832040

Their sages would ponder on these numbers. Conveniently, they would use a standard 52-card deck of playing cards in their meditations, a copy of which was provided to your team at the beginning of your adventure.

They would first discard the ace, jack, queen, and king cards. Then, they would use as few of the remaining cards as they could to create a deck that “witnessed” as many of the golden numbers as possible. For example, the deck shown in the attached image witnesses 10946, 17711, 46368, and 832040, because each number’s digits appear in order within the deck (skipping over other digits as needed).

Given all the time Dr. Jonas dedicated to studying this tradition, I think it’s worth your time to try it for yourself!  
-BF

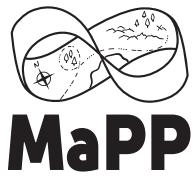
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Bring the smallest deck you can that witnesses as many golden numbers as you can to Game Control. It will be scored using the following formula:

$$([\#Golden Numbers] \times 50) - [\#Cards Used]$$

So the attached example would be worth  $(4 \times 50) - 16 = 186$  Victory Points.





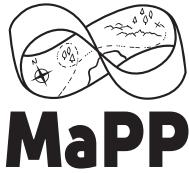
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## A Loose Thread

	81	27	9	3	1
2	Jan ??	Feb ??	Mar ??	Apr ??	May ??
1	Jun ??	Jul ??	Aug 09	Aug 10	Aug 11
0	Aug 12	Sep ??	Oct ??	Nov ??	Dec ??

## **Part III**

# **Solutions and Credits**



# MaPP Challenge '20 – Mindy Jonas and the Enigmatic Legacy **Solutions**

## Location Puzzles

- Main Puzzle 1: 972
- Main Puzzle 2: 018
- Main Puzzle 3: 560
- Main Puzzle 4: 344
- Cryptic Puzzle 1: 820
- Cryptic Puzzle 2: 167
- Cryptic Puzzle 3: 225
- Cryptic Puzzle 4: 415

## Main Puzzle 1

cgovx

## Main Puzzle 1 - Part 2

STAR

## Main Puzzle 2

- August 09: sG-rF-qE
- August 10: uE-vD-wC-xB-yA-zF
- August 11: nD-jE-kF-IG-mB-hC
- August 12: tC-uD-oA-pB

## Main Puzzle 2 - Part 2

I WANT TO BELIEVE

## Main Puzzle 3

- Village Market: PIPII

- Market Square: PPIIP
- Black Market: IIIPP

## **Main Puzzle 3 - Part 2**

ALIEN

## **Main Puzzle 4**

A11-B17-C17-D49

## **Main Puzzle 4 - Part 2**

SPACE

## **Cryptic Puzzle 1**

HISTORY

## **Cryptic Puzzle 2**

PRIME

## **Cryptic Puzzle 3**

SIEVE

## **Cryptic Puzzle 4**

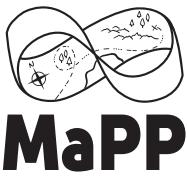
LIBRARIAN

## **Metapuzzle**

ERATOSTHENES

## **Hidden Puzzle**

TRIAD



MaPP Challenge '20 – Mindy Jonas and the Enigmatic Legacy

## About the Game

### Credits

Thanks for downloading the puzzle booklet for Challenge '20 by Mathematical Puzzle Programs. These puzzle materials are provided as-is for use in the classroom (or anywhere else!) to help showcase the fun of mathematical problem-solving.

We'd love your feedback on how to improve our events. You can contact us by email at [info@mappmath.org](mailto:info@mappmath.org). More information on Mathematical Puzzle Programs may be found at our website <http://mappmath.org> and on our Twitter @MaPPmath. Happy mathematical puzzling!

- MaPP Directors and Volunteers

## Mathematical Puzzle Programs Leadership

- Steven Clontz — Director
- Braxton Carrigan — Associate Director
- PJ Couch — Associate Director
- Jared Holshouser — Challenge '20 Lead Author
- Kat Perry— Puzzle Contributor

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