**Dear Mister Gardner:  Apocryphal Letters from Children to Martin Gardner**

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**ABSTRACT**: In the fall of 2014, a group of six students got together for an hour per week to celebrate the Gardner Centennial. The students were all ten years old. They met in a Math Circle to explore the Gardner's life, influence, and mathematics. The mathematical goal of the course was to develop students' mathematical thinking by seeking patterns when none are obvious and by seeking ways to crush seemingly-obvious patterns that aren't really patterns at all. The students experienced great joy while doing so. The facilitator kept a written record of the students' reactions, work, comments, and questions, all of which have been reorganized by the facilitator into a series of letters to Martin Gardner. The letters are paraphrased with some direct quotes interspersed, with the hope that Mister Gardner would have enjoyed reading them.

**September 23, 2014, Week 1**

Dear Mister Gardner,

We're a group of six kids meeting six times in a Math Circle in Philadelphia. We're ten and eleven years old. We're celebrating the Martin Gardner Centennial.



Our facilitator Rodi said that you mutilated a chessboard. Strange. In your problem "The Mutilated Chessboard," you asked if we remove opposite corner squares, can we cover it with 31 dominoes?
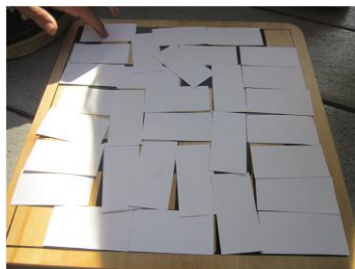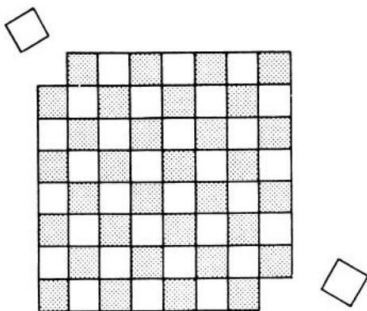


We had a lot of questions about it. First of all, can we please use more than 31 dominoes? We're wondering whether 31 dominoes is enough to cover the whole board? Why are we using paper, instead of real dominoes?  And can we switch the position of the removed squares?

We had a lot of ideas about how to solve this problem. We could let the dominoes go on top of each other. We could tilt them. We do think that 31 dominoes seems like enough to cover 62 squares since 31+31=62, so it should work. But, it might not be working b/c there are not really 31 dominoes here (let's count them!). It doesn't seem to work – maybe because of where the removed squares are? Wow, Mr. Gardner, you really know how to write a great question. At this point we're thinking that it doesn't work with diagonal corner squares removed, but it does with corners that are next to each other.
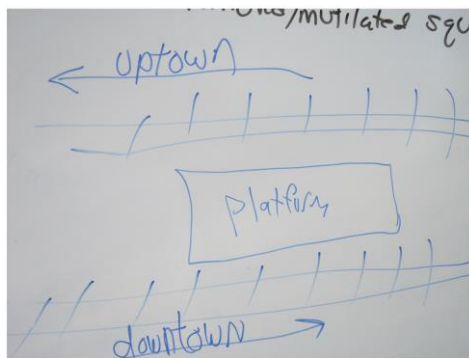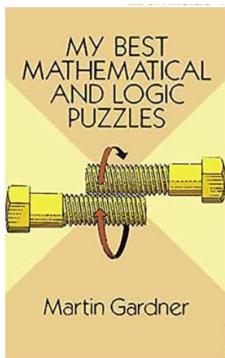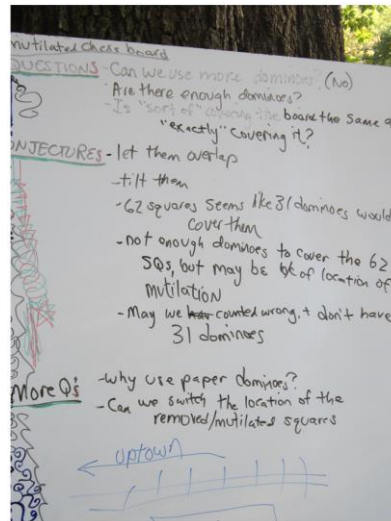








Rodi also showed us your problem Bronx versus Brooklyn. She gave it to us with a new wording but kept the math the same. After half an hour, we came up with the same explanation that you did! We figured it out because every time someone said something, even if it was wrong, it helped us with our next idea. We were sad that time was up in our class. We asked Rodi, "Are there more problems like those?"
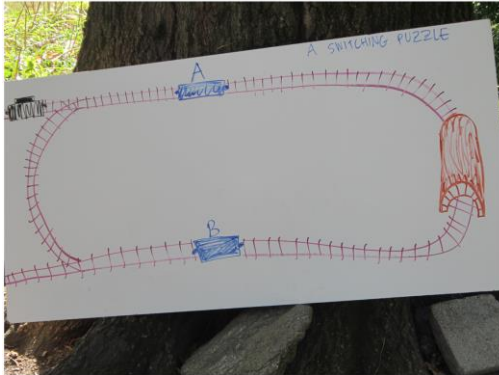
Sincerely,

Crystal, Candace, Akira, Hudson, Mckenna, and Lily


**September 30, 2014, Week 2**

Dear Mister Gardner,

Rodi put on the whiteboard a drawing of your problem "A Switching Puzzle." We did not let her tell us what the question is; we wanted to guess it.



We asked a lot of questions and came up with a pretty good question for this picture, but it was not the question you asked about. We got to work on your question by tracing train routes with our fingers. Unfortunately, that erased the drawing! So we started to use the markers as trains, which worked well since they can be attached to each other.



All of us were not at the board, though. Lily sketched it out in her notebook and Crystal was just sitting there, seeming to do nothing. Turns out she wasn't doing nothing. At the same time, both Lily and Crystal jumped up and said "I think I've got it!"

"I think I've got it," is the thing we say the most often in Math Circle. The next most-common thing we say in Math Circle is, "Oh wait, never mind." We all did end up at the board working together to come up with the same solution that you did. It was a combination of working together and working alone, like real world work. Every time one of us said something, it made another one of us think of a new idea.



Next, Rodi showed several maps that were like a lot of other paper maps, easy to unfold and hard to refold in the same way. We're used to Google maps, so we didn't know this. After that, she said, "I just can't figure out a certain puzzle no matter what I try." That got us so excited! The puzzle was called The Folded sheet by Henry Ernest Dudeney that you wrote about in one of your books. Rodi said she worked and worked on this puzzle. She read the instructions in the back of the book. She watched a video on YouTube that had hints but not the answer. She was hoping that we could help her.

We tried and tried too.  We didn't get very far – just 1 then 2 in their places.  Mckenna made her own "map" out of a new paper with larger squares.  Soon everyone could get 1, 2, 3.  Candace made a new map with tiny squares.  After a while some of us could get to 4.  Then we all agreed that there must be some kind of weird fold, maybe like a diagonal.  Some of us tried this and made it to 6.  Hudson even got to 7 but lost 8 in the folds.  By then, we were so frustrated!  We decided to take our maps home. We made Rodi promise to bring the book with your instructions next time.

Rodi thought then would be a good time to give an "easier" puzzle: your "Folding Money Fun."  You show in pictures and words how to take a dollar bill and fold it one way and unfold it in the same way, but George Washington ends up upside down. Rodi asked us to draw Washington's face on the back of our maps, which were the size of a dollar bill. We needed extra time to get Washington's hair just right, but Rodi told us not to worry about this because it didn't have to do with the math we were doing.

The question you ask is "Why does the bill turn around?" It would have been better had Rodi asked us "Can you follow these directions and get the same result?"   You say that "If you have followed the illustrations exactly…"  But it isn't so easy to follow the instructions exactly.   It's hard to "fold forward and to the left."  Especially 'cause we're only 10 and we recently learned our directions.

Only two of us were able to follow the directions.  The rest of us got so, so frustrated!  The two of us who could do it were sitting closest to the book.  Rodi should have given each of us our own set of instructions!  But she wants us to do everything collaboratively, with everyone doing the same thing at the same time, and asking each other for help. If we have to do things that way, maybe this just isn't a good problem for our group.   So far, "Bronx vs. Brooklyn" seems the be the most successful puzzle for our group – we were super-interested, thinking hard, working with our friends, and nothing that was hard for us to do with our hands like folding or cutting.  "A Switching Problem" was a great problem for us too – since we talked more than using our hands. Next time, Rodi plans to make one very large dollar bill for everyone to fold together.  But then she would get to have all the fun drawing George's hair!
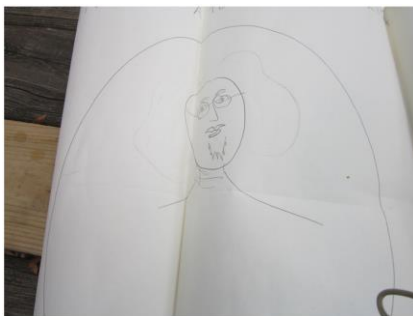


Anyway, the two of us who did figure out how to turn George upside down did realize the answer to your question.  The rest of us struggled with the folding. Crystal got so frustrated that she doesn't want to do paper folding ever again. The rest of us are willing to give it a chance. And we are not blaming you. At the end of today's class, we finished with some of your riddles and word games, so we all left with a smile.

Sincerely,

Crystal, Candace, Akira, Hudson, Mckenna, and Lily

**October 7, 2014, Week 3**

Dear Mister Gardner,

It turns out that the last two weeks Rodi was telling a few of your problems from what she remembered, instead of reading them directly from your books. So today, we got to hear your versions of some of the problems. We thought the way you talked was confusing! (But Rodi thought that your wording was incredibly clear and that our vocabularies are lacking. We are only 10, after all.) When we heard "A Switching Puzzle" in your words, we couldn't remember how we solved it before. We wanted to make sure we were following all of your rules, so we re-solved it. That was fun!



Rodi asked us to go back to "Folding Money Fun." This time she had prepared a big paper dollar bill. We were very excited, so we fought over who got to draw in George Washington's hair. Each of us did a different section of the bill and folded while listening to the directions. We did it a few times. The good news is that by this time, we were all sure of how to trick our friends (and parents!) with this puzzle, and we also knew why it works. The bad news is that we couldn't all hold the large bill at the same time. Rodi should have made it at least 4 or 5 feet long because in this problem, the way it's facing matters – we have to all be on the same side for the folding to be able to follow along.



Next we went back to "The Folded Sheet" with an extra-large number map. Rodi read aloud your instructions as we folded. Unfortunately, one of us, we're not naming names, got so excited that they took charge of folding the map. Another of us got frustrated with that bossiness and walked away. And another played the peacemaker and brought that student back.

Rodi asked everyone to work together, but it was too late.  She likes to try to become invisible in Math Circle, but should have told us what to do when things got too intense. We worked together but we were grumpy.  One of us suggested that everyone fold their own map. You know, Mister Gardner, that Rodi does not like doing it this way, that it isn't collaborative enough for her. She didn't have extra paper anyway, so we tried doing one large map for a bit without arguing but also without a solution.



Did we mention that we were having class outside on picnic tables? On one of the tables today was a large, laminated copy of your "Maze of the Minotaur" with some smaller copies of something that looked the same.  We moved to that table without being told when we lost interest in the Folded Sheet. Since most of us are big fans of Percy Jackson's adventures, we asked repeatedly "Is this the labyrinth of Theseus?"  All she would say is "What do you think?" and  then we argued about it.

Most of us started tracing the large path with our fingers. Our fingers walked all over it trying to figure it out. While we were working, we heard that you said *'No one has ever drawn a maze that looks easier to work, but actually is so difficult.'*  Rodi thought she was a smarty pants because she initially thought she had solved it in about 2 minutes, so she thought we'd be able to do it without getting annoyed. She drew a larger version for us and she couldn't solve it. Smarty Pants Rodi thought she must have drawn it wrong. But she hadn't. …she started to realize that you were right. … She started asking us the questions she was wondering  so that we could help her figure it out…. It turns out that she didn't have to ask us questions at all because we were wondering the same things:

- Is there actually a pattern in the solution?
- What's the difference between a maze and a labyrinth?
- Is the solution manageable?
- Are there useful strategies for drawing the maze?

After a while, finally one of us successfully solved the maze. And guess what: we weren't arguing anymore! We were very calm. Do you think this calmness was from walking our fingers in a labyrinth?

Rodi read aloud some parts of the new Scientific American article about you. We enjoyed hearing about your playfulness. And it was nice, too, for us to see a picture of you. You are not a guy from ancient history!
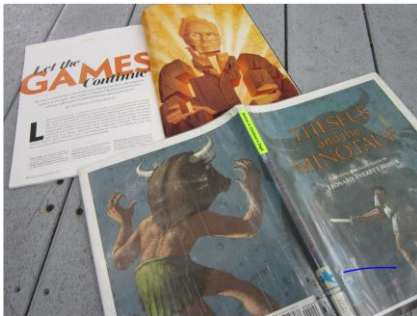


Rodi ended class with one of your math puzzles that involved no objects – no pen, no paper, no chessboard, no poster, no giant dollar bill, no nothing. Scrambled Box Tops. It went like this:

*"Imagine that you have three boxes: one containing two black marbles, one containing two white marbles, and the third, one black marble and one white marble. The boxes were labeled for their contents – BB, WW and BW – but someone has switched the labels so that every box is now incorrectly labeled. You are allowed to take one marble at a time out of any box, without looking inside, and by this process of sampling you are to determine the contents of all three boxes. What is the smallest number of drawings needed to do this?"*



We made some progress toward the solution, but then we were out of time. Rodi really needs to teach it differently next time so that everyone is talking; today only 2 of us talked the most. And  they didn't

even agree. They worked on the problem totally differently. One of us drew it, the other was thinking about it. Both ways actually helped.  How did you figure it out, Mr. Gardner?

Sincerely,

Crystal, Candace, Akira, Hudson, Mckenna, and Lily


**October 14, 2014, Week 4**

Dear Mr. Gardner,

Rodi opened up a box and said "I'd like to show you my creatures,"

"That's a Go board," protested Crystal.

Rodi said "No, this is the habitat of my creatures.  It does resemble a Go board, but it's not one.  I'd like to tell you about how this species of creatures exists over time."  She placed a few black counters on the board and said "They can live if they have 2 or 3 neighbors."


"What if they only have one?" asked Akira.


"Then they die."  Said Rodi

"Of loneliness," added Mckenna.

"What if they have 4 neighbors?" asked someone else.

"They die."  Rodi went on like this for a few minutes. We asked a bunch of questions and figured out the rules of death and survival.  "In real life," Rodi said, "something else happens besides survival versus death."
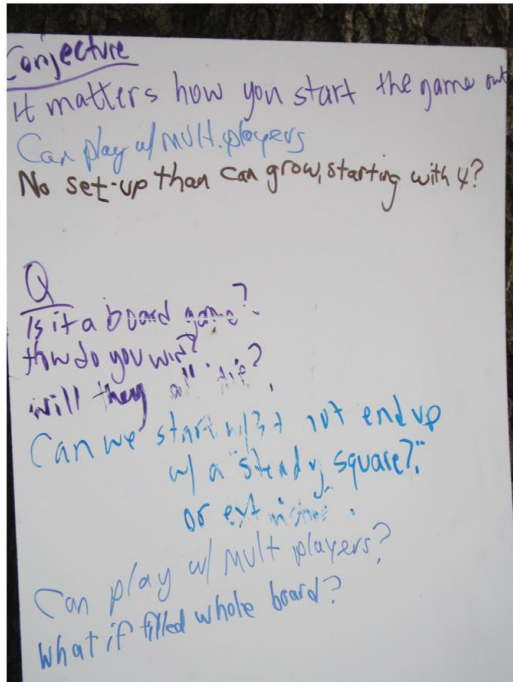
 After a couple of guesses, Hudson said "new ones are born!"  He was excited. Then Rodi explained the rule about births – they only occur in a cell/location with exactly 3 neighbors.

 "Is this something Martin Gardner invented?" asked both Lily and Mckenna.

"No, but… " Rodi started to say, and before she got the sentence out, we all said "Martin Gardner made it famous."  We get what you do. Rodi showed us your article about it.

 "Are you going to ask us if we can fill the whole board with creatures before they die out?" asked Lily.

Rodi said "That's a really interesting question to explore.  Today, though, I wasn't going to ask you any questions.  My plan is just to show you the creatures and the rules they live by, and have you all come up with questions."

Conjecture
It matters how you start the game out
Can play w/ Mult. players
No set-up than can grow, starting with 4?

Q
Is it a board game?
How do you win?
Will they all die?
Can we start w/3+ not end up
   w/ a steady square?
   or ext in time.
Can play w/ Mult players?
What if filled whole board?

"Is it a board game?" asked Mckenna.  Rodi said let's try it out and see what we think is the answer to that.  We started to play and had a bunch of questions and ideas:

- "It matters how you start the game"
- "How do you win?"
- "Will they all die?"



We played more and saw that some initial positions resulted in immediate or quick death to all, some seemed to keep going, and some ended up in a stable position. We called that a "Steady Square."  We wondered if there are answers other than a steady square or death?
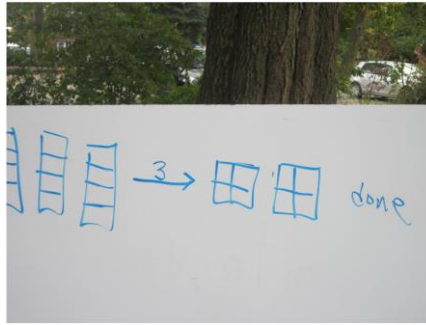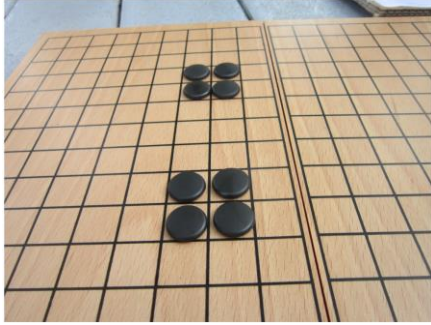
While we worked, Rodi told us about how this game was one of the early ways people used math modeling to predict outcomes for populations of species. "Oh no, Ebola!" we said. "Yeah, people with the wrong number of neighbors might die of Ebola!" we said. We were a bit nervous so asked Rodi "Is that how it works in real life?" She told us that it's just a game, and its purpose mainly is to get us thinking. It isn't human lives and deaths. Remember, she said, many factors influence our survival. All this game specifically examines is population density.

Almost an hour later, we were still at it, and then it was time to go home.

Sincerely,

Crystal, Akira, Hudson, Mckenna, and Lily

**October 21, 2014, Week 5**

Dear Mr. Gardner,

Candace wasn't in class last week and was early for class today. She walked in and saw our work on the board from last week. She asked, "Why does it say 'die?'"

Crystal and Lily were also early for class, so Rodi told Candace to "Ask them." Crystal set the board up for Life. Then Lily explained the rules.

Rodi seemed to think that some of Lily's explanation didn't make sense, so she rudely interrupted. "I think Lily is doing a <u>fine</u> job of explaining," said Crystal. Crystal was right. Rodi did need to butt out. Rodi sometimes has that annoying teacher habit of butting in. She needs to work on that.

Then Hudson got there and said "I've been thinking about it all week and still can't figure it out."

"<u>What</u> are we trying to figure out?" asked Candace.

Before anyone could answer her, Akira joined the group and joined into the demonstration of the rules for Candace.

"But *what* is The *Question*?" asked Candace several times. We explained that the goal is to see whether any initial patterns could generate ever-expanding life. We disagreed about how to figure this out. A

few of us wanted to take turns randomly setting up patterns and seeing what happens. We had done that for a while last week, until your article helped us to realize that a system starting with 1 creature might be good. You and Mr. Conway called them "counters."  Rodi calls them "creatures," and we laugh when she forgets and refers to them as counters or stones.

Rodi was being a little pushy. We think she was getting a bit stressed to solve things since we only have one more class after today. She said, "Since we started to use this system last week, let's give it a chance, and if you don't want to keep going with it, we can change the way we're doing it."  So we did. Rodi kept track of the results on the board. After about 20 minutes, a few of us got bored.  Actually, more like frustrated.  At this point, we had tested 7 set-ups today and some more last week, and none had continued growing after 2 or 3 moves.  Rodi told our grownups that those 40 minutes of perseverance last week plus 20 today adds up to an hour of very impressive determination for kids our age.  We had discovered that some set-ups lead to "death" (or what you call extinction), some to the "steady square" (or what mathematicians call a "block"), and some to the "infinity turn" (or what some of your friends call a "blinker" - a type of "oscillator").  We really enjoy naming these patterns! But so far, none continued growth.
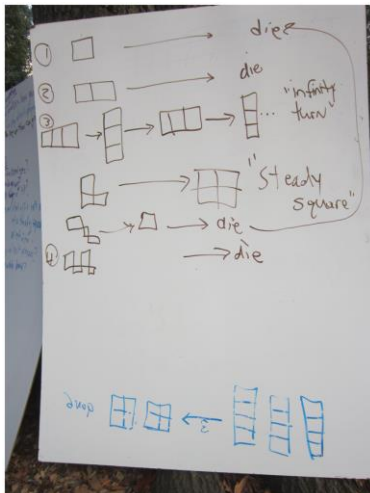


We were excited to hear that in the olden days of 1970 you helped Mr. Conway offer a $50 prize to the first person to prove or disprove the conjecture that "no pattern can grow without limit."  We were wondering about too!

So anyway, Rodi admitted that this very boring approach to the problem does get tedious.  (These days, Mr. Gardner, this type of problem is done on a computer.)  We definitely would have had more fun randomly trying different arrangements/numbers of counters until we discovered our own method. Creating the set-ups from our imaginations instead of a rule is definitely more exciting.  Is that what real mathematicians do?

At this point in class, two of us were talking about things that didn't have to do with math. One hard thing in this math circle is that we REALLY like each other, but only see each other for this one hour per week.  We want to socialize too!

Two of us were focusing on playing Life, and one was doing both.

Rodi said, "I think we're ready to put our attention on something else."

"I'm not," protested Hudson.

"I know you're not," said Rodi.  "I know that you could work on this problem all day long."

"Yes I could."

"Let's try to come back to it later today if we have time."

"Okay."

So, we moved on.  At this point, we have 2 working conjectures about Life:

1) There are no set-ups that can grow, starting with 4 creatures.
2) There is at least one set-up that will result in continuous growth.

Our group disagreed.

Okay, time to talk about something else:

MURDER…

…at the Ski Resort.

Since some of us were getting bored, we moved to a different table, and Rodi read us one of your "Tricky Mysteries."

*"A Chicago lawyer and his wife went to Switzerland for a vacation.  While they were skiing in the Alps, the wife skidded over a precipice and was killed.  Back in Chicago an airline clerk read about the accident and immediately phoned the police.  The lawyer was arrested and tried for murder.*

*The clerk did not know the lawyer or his wife.  Nothing he'd heard or seen made him suspect foul play until he read about the accident in the paper.  Why did he call the police?"*

We asked question after question after question, coming up with conjecture after conjecture after conjecture.  After a few minutes, we realized that to test each conjecture, it was helpful to re-read the problem to see if the conjecture violated any of the rules.  (Rodi was so impressed that we came up with this great math skill to on our own. C'mon, Rodi, we are ten already!)  We discussed, while all Rodi really did was re-read aloud the problem, or parts of it, repeatedly, when we ordered her to.

Finally, Lily, Akira, Crystal, and Candace agreed on an answer: "*The clerk was familiar with the precipice, and knew that it wasn't a dangerous place.  Therefore the husband must have done something intentionally to make it dangerous.  He pushed aside and piled up the snow to make her fall over the edge.  Something in the newspaper article revealed specific info about the precipice, raising the clerk's suspicions.*

Hudson disagreed. "How could you push aside that much snow?!" demanded Hudson.  The rest of us came up with an answer that made him change his mind.  We all agreed now.  We looked at Rodi. "We came up with a solution," said Candace.  We demanded that Rodi re-read the problem to double check. We then agreed that nothing in our solution was wrong.  Triumph!

"What does Gardner say the answer is?" asked Lily.

"Do you mean to ask what he says 'an' answer is?" asked Rodi.

"I mean, what does he think the answer is?"

Here's your explanation, Mr. Gardner: "The clerk had sold the lawyer a round-trip ticket to Switzerland, and a one-way ticket for his wife."

"Round-trip!" Crystal exclaimed. She jumped out of her seat.  "That is so good!"  She loved Gardner's explanation.  The rest of us were frowning.

"That's it?" we asked.

"Yep," Rodi said.

"Let me explain to you how round-trip tickets work," said Crystal to the group.  She thought (and was probably right) that not everyone understood.  She explained, but the rest of us were NOT impressed.

"There could be many reasons that they weren't planning to travel home together," suggested several people.  We talked about this.  We decided that your "answer" left a lot to be desired.  Rodi talked to us about the power of our logic – how causal assumptions can be knocked down/weakened with alternative explanations.  She said the causal assumption here was the clerk's, and possibly the police's, assumption that if the couple went to Switzerland on vacation together, that then they would/should return together.  We did not accept that assumption, and therefore we do not accept your solution.

"Ours is better," said Candace. She was excited.  We all nodded.  Even Crystal was convinced.

Rodi was, of course, thrilled that we were so willing to disagree with such a famous smart person.  Our open-mindedness is so inspiring to her.  Her (boring) adult mind, of course, is too caught up in your fame.  Rodi didn't even think she would ever come up with a different solution to one of your problems, even though she knows people do all the time.  That was one of the big points of your column in Scientific American, right?  That plain old regular people like us might have a better idea than you did about how to solve a problem.  We love this about you, and so does Rodi, even though she still feels intimidated.

Finally, we came back to your problem Scrambled Box Tops.



"I know the answer!  Please, please, please let me say it!"  begged Crystal right from the start.  Rodi knew that Crystal knew a good answer because when we first tried this problem 2 weeks ago, Crystal saw the solution and said it right away out before Rodi could stop her.  But last time, the rest of us were

still trying to understand the question when she explained it.  So no one knew what she was talking about.

But now everyone understood the problem.  Lily and Akira were wiggling in their seats with solutions too.

Rodi said "I see you have an idea of what the solution might be, but so do some others.  Let's make sure everyone gets a chance to state their conjectures."

"Let's raise hands," suggested someone.
"Good idea," said someone else.

Rodi said "If that's okay with the rest of you, I'll let Crystal go first and everyone will get a chance."  The others agreed, as they could tell she was excited.   Most of us raised our hands, so Rodi went around the table asking everyone for their conjectures. Here are our conjectures:

> *Crystal – If you pick a random marble out of the box labeled BW first, you can figure them all out from one.*
>
> *Lily – if you pick one out of BB or WW first, you can do it in two draws, and one if you're lucky.*
>
> *Candace – I don't know.*
>
> *Akiru – I can't remember. (He had lost his train of thought, even though he had an idea a couple of minutes ago. Frustrating. Rodi said this happens in math - Now you see it, now you don't.)*
>
> *Hudson – I want to see it!  We could use items from the Life/Go set as props.*
>
> *Rodi said, Okay, let's do it.*

So we acted it out and agreed that both conjectures work.  We were all satisfied and it was time to go home.

Sincerely,

Crystal, Candace, Akira, Hudson, and Lily


**October 28, 2014, week 6**

Dear Mr. Gardner,

Our last class was today. Mckenna wasn't here last week, so we began by explaining our problem to her: How can we figure out if any set-ups in Conway's Game of Life lead to a pattern of continued growth?

The method we started using is helpful.  But it's boring! We looked at all of our results from the prior 2 weeks. "What should we do?" Rodi asked.

"Let's just do our own set-ups," said pretty much everyone.

Hudson had come to class with something he had been thinking about during the week – starting with a solid rectangle at the corner of the board.  He wanted to try that.  Akira wanted to test a 3x3 square that was empty in the middle.  Seeing these 2 set-ups triggered Mckenna and Candace to want to test what happens when you set up "half the board" (a 4x8 rectangle).  For the past 2 weeks, Lily had been asking whether it's possible to fill the whole board, but unfortunately, she wasn't here today. Crystal was a bit disappointed to not have a conjecture of her own, but she watched the others test some of these hypotheses.  Four of us were working from 2 boards (one a Go board, the other Othello).
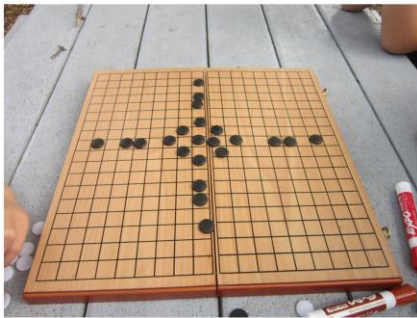


As we worked, people started throwing counters across the table occasionally.  Rodi kept us calm with some of Mr. Conway's backstory (at our request).  She read to us from a very entertaining article.  Who knew that mathematicians could be interesting?

"Here's a photo of him.  He's still alive, and he leaves nearby."  Rodi told us.

Akira nearly leapt out of his seat.  "Then there's still a chance that we could get the prize!"  he said excitedly.  Everyone wondered whether Conway was still offering that $50 that in 1970, you helped him offer to anyone who could prove or disprove that ever-expanding growth was possible.  We discussed how little this prize was for such a famous magazine. We also wondered if we could visit Mr. Conway.

While we worked, Rodi told us more of Mr. Conway's backstory from the article.  She thought we didn't notice, but we did notice that she stopped talking when the Life exploration got more intense, and then resumed the stories if anyone starting throwing stuff.  Here are some of the things we talked about:

1) mathematical topics Mr. Conway is known for. We like the reminder that math is not simply arithmetic.  We didn't know that one can be a "knot theorist."  We also loved that Mr. Conway created a new number system, "surreal numbers."  Four of us had created "Pumpkin Numbers" last year in our course about named number types.
2) a funny quote about Mr. Conway's enjoyment of teaching
3) Mr. Conway's Free Will Theorem (Rodi was so excited when she read about this; it changed the way she thought about things.  But we kids were not in awe of this new idea at all since our thinking is fresh.)
4) Mr. Conway's opinion that the Game of Life is really "rather trite… trivial"
5) Mr. Steven Wolfram's disagreement with Mr. Conway about the relevance of Life
6) how/why Mr. Conway came up with Life – he was seeking simplicity
7) an expensive arithmetic mistake he made when offering a large cash prize.  "And he's a mathematician!" said Mckenna.  We were relieved that everyone makes mistakes.
8) why he suspects he may be a bad influence on people

9) his "recipe for success" in a mathematics career

Then Rodi told us something surprising about your friend Mr. Conway. "One more thing I forgot to mention from the article. He went to prison." Some of our eyebrows shot up at that. Not Crystal's though.

"Yeah," she said. "He seems like the kind of person who would have gone to prison."

"For what?" the others asked Crystal.

"For something really awesome!" she replied. Rodi quoted the article about Conway's 11 days in prison for participating in a "ban-the-bomb" protest. This was exactly the type of "crime" that Crystal had in mind.

"No one would get arrested for something like that in our times," said someone, but not sure. Then we argued whether it really "counted" as "going to prison" if he spent "only 11 days" there. We doubt you've been to prison. Have you, Mr. Gardner?

As we talked, we were making ground with our Life progress. With these new set-ups, things were neither stabilizing nor dying after just a few moves. The shapes of the populations were changing dramatically. We got a new idea: "If you fill the whole board or larger (rectangular) area, all but the corners will die and a new row will be born!" The half-board and open square that Candace, Mckenna, and Akira had started at the beginning had morphed into new shapes. Hudson's smaller corner rectangle had gone extinct, so he started testing a new set-up.

More work, more stories. Candace and Mckenna got very excited. Their half a board had morphed into two "steady squares." The conjecture morphed into "we're done, it won't die, but won't grow anymore either."

Then Candace asked hopefully, "Should we name it?" The others nodded. Rodi asked Akira for a name for his set-up; he called it "The Three-Square." Rodi asked Candace and Mckenna- they named theirs "Half the Board." Hudson didn't name his.

While we were naming formations, someone noticed that the two steady squares on Candace and Mckenna's board were just one diagonal unit away from each other. So a birth could occur! The end was not near, maybe. We went back to work, and Rodi to storytelling.

Then, sadly, the Half-Board set-up died after many moves. Candace and Mckenna decided to restart, from the position where 2 steady squares were one diagonal unit apart. As they worked that, we put our findings so far on the board:

- The Three-Square: about 20 moves in, it was still growing
- Half-the-Board: died after 20-30 moves
- H's second set-up: still growing with 10 moves

Then something really interesting happened. (For four of us, *all* of this was clearly interesting, we said "this is fun" more than once. For Crystal, it was not very interesting – probably because she didn't have her own conjecture to test. Fortunately, she is a huge fan of biographies so thoroughly enjoyed the stories about Conway.)

Anyway, here's the interesting thing we were about to mention:  Candace and Mckenna's new work with the 2 steady squares kept growing past the point where it did before.  How could this be?  Did we make a mistake? This set-up started in a different place relative to the edge, so does it matter where you place your set-up on the board? We wish you were here to work on this with us, Mr. Gardner. And that we had a larger board. Maybe an infinite board or a computer program.

Rodi asked us whether we could trust that any of these patterns that were growing at this point would continue to grow.  We guessed how many moves would be enough to be sure:

- 30 moves?
- 50 moves?
- 1,000 moves?
- No such number/you can never be sure?  (After we discussed this for about half a minute, everyone agreed with this conjecture.)
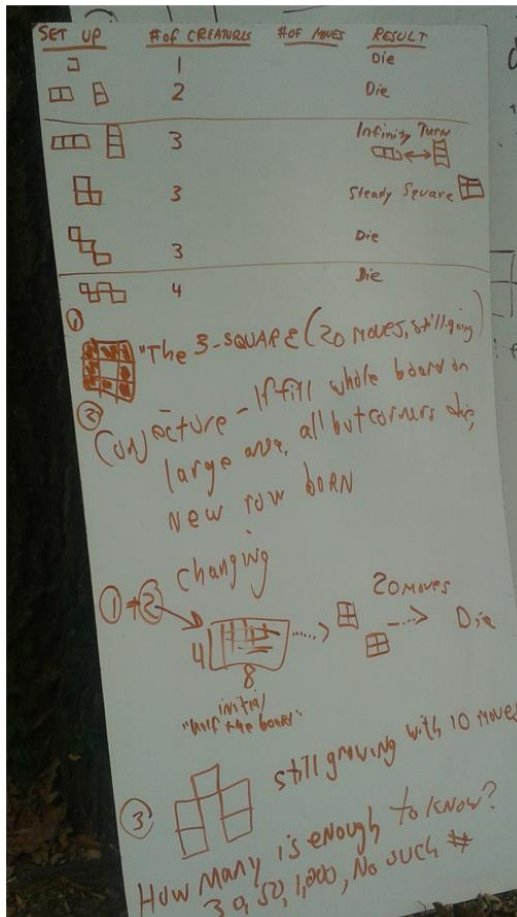


Since today was our last class, we discussed how to continue to play Life at home.  Hudson said, "I want a Go board."

As he mentioned last week, and the week before, Akiru said "I want to learn to play Go."

"I can teach you," said Crystal, as she did every week. But Rodi never make time in class for this to happen. Then we came up with other ways to play Life at home if you don't have a Go board: Othello, Scrabble, possibly checkers, home-made with paper. (Some of these options, we thought, don't offer enough squares to progress very far.)

We had about 10 minutes left. The kids requested another of your "Tricky Mysteries." So Rodi read us

Funny Business at the Fountain:

> "At a hotel in Las Vegas, a lady rushed out of the manager's office to get a long drink at the water fountain in the lobby. A few minutes later she came out for another drink. This time she was followed by a man. There was a mirror behind the fountain. When the lady raised her head, she saw that the man behind her had a knife in his upraised fist. She screamed. The man lowered his knife, and then both of them began to laugh. What on earth is going on?"

Crystal immediately announced, "I have an answer!" A person working in the office was trying to sell a bunch of stuff to the couple at the water-fountain. It was really annoying. They wanted to get away from the person who kept trying to sell them stuff. They couldn't pull themselves away. So they faked the knifing attempt to distract the salesperson from the sales pitch. And it worked."

We had other ideas too, most involving some sort of prank. Since last week we solved the mystery by checking and rechecking the exact wording of the problem from the book, we did that again. We decided that we liked Crystal's solution best. Of course, we then demanded your explanation: *"The lady had the hiccups. Her boss was trying to stop them by frightening her."* Our solution is better. What we mean, Mr. Gardner, is that we all appreciated the logic in your solution, but just like last week, we appreciate our own solution more.

Then it was time to go. Thank you for giving us 6 weeks of math fun.

Sincerely,

Crystal, Candace, Akira, Hudson, and Mckenna

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**APPENDIX**

ADVERTISED COURSE DESCRIPTION: Before there was Vi Hart, there was Martin Gardner. Celebrate the Martin Gardner Centennial with an exploration of Recreational Mathematics. For 25 years, Gardner wrote the Mathematical Games column in Scientific American, and became legendary for his unconventional approach to mathematics. In this circle, we will explore his life, his influence, and of course, his mathematical puzzles. The goal of this math circle is the same as the goal for all of them: to develop mathematical thinking. Recreational mathematics is yet another avenue for seeking patterns when none are obvious, and for seeking ways to crush seemingly obvious patterns that aren't really patterns at all.

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**AUTHOR'S NOTE**

These letters are constructed from the following blog posts, which describe each session in detail:

https://mathrenaissance.com/martin-gardner-1-mutilated-chessboard-and-bronx-vs-brooklyn/

https://mathrenaissance.com/martin-gardner-2-switching-and-folding/

https://mathrenaissance.com/martin-gardner-3-maze-of-minotaur-and-scrambled-boxtops/

https://mathrenaissance.com/gardner-4-conways-game-of-life/

https://mathrenaissance.com/gardner-4-life-murder-and-box-tops/

https://mathrenaissance.com/gardner-6-more-life-and-besting-gardner-again/

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