

Cosmos Ignites

(A sequel to *Marie's Atlas*)

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This book is dedicated to those who ask questions - for those who seek truth.



* RECURSIVE BEGINNINGS *

The ocean reminded Marie of the Sea of Time that had tested her very being over a year ago. She sat at the threshold of previous waves where her toes could soak in the wet sand while sifting her hands through the dry sand. She relaxed in her intertidal tranquility. She listened to the sounds of the breeze and watched the waves. She was entranced by all of it.

As she sat there, she remembered Atlas and her last adventure. Thoughts of her quest often brought her to a daydreaming state. She wondered what other mathematical puzzles were lurking in faraway galaxies. What other adventures were waiting out among the stars?

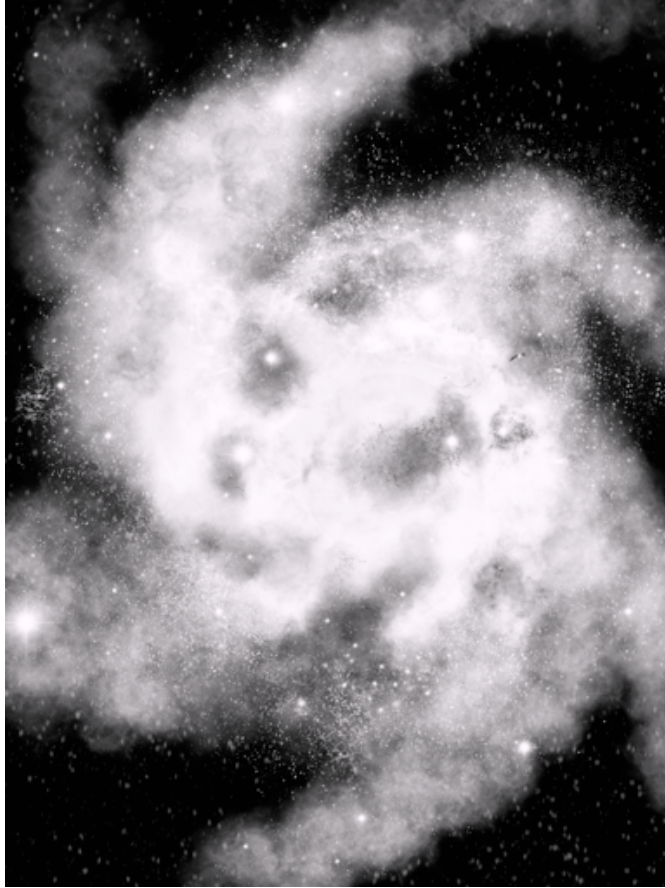
Marie's parents were on a new scientific assignment. They were happy to be on the ocean for a change. Most of their time so far had been spent in deserts. They were working with scuba diving teams to recover two unique finds. A small meteor had hit the continental shelf and the impact had revealed fossils further down the coast. They had two teams of scientists (one for the meteor and one for the fossils). Marie's parents were overseeing both teams. They were experts in paleontology and geology.

Marie and her parents were living the same way they always had. Digging, casting, shipping, exhibiting, and publishing had all been a part of their routine. Her homeschooling education was as fun as ever. She was expanding her learning of computer programming, science, mathematics, chemistry, literature, and the world. Moving to the ocean was a continuation of her family's nomadic lifestyle of pursuing scientific discovery.

Recently, new curiosities of fractals and chemistry had been ignited within her. She had stumbled across the subjects in a library and had gotten hooked immediately. She hungrily ate up every book on fractals. Some of her curiosity stemmed from her last adventure. And she longed for another chance to be a hero again.

She saw spiral fractals everywhere around her. The ocean waves were repetitive and spiraling into the rocks and sand. The shell at her fingertips had a perfect spiral within it. She saw spirals at night when she looked through her telescope at the galaxies far away. Those moments

really made her long for another adventure.



Chemistry was part of her scientific studies. She really focused on studying atoms, elements and reactions. She loved the idea that everything was made up of matter consisting of extremely small objects called atoms.

Suddenly, a whistle blew, snapping Marie out of her daydream. She looked up and saw a familiar boat that had blown its whistle. It was coming in from the meteor

recovery site up the coast. She lifted the binoculars from around her neck to get a closer look. The boat was coming into the marina adjacent to the lab where her parents worked.

“It’s so low in the water.” She said to herself.

“Sure is!” Her dad said with excitement. He sat down next to her.

“Hey! You startled me. When did you get here?”

“Just now. I got a call from the crew about an interesting find with the meteor. They are bringing all of the meteor pieces down here. I would like to get it into the lab where we have the tools and resources to study it better.”

“We?”

“Well, it’s in pieces and who is better at fitting together pieces than you?” He nudged her arm. “This meteor seems to have a peculiar behavior as well.”

“Really? It’s in pieces?”

“Let’s go see.”

They walked down to the boat dock and met the crew. Marie saw just how low the boat was in the water, its cargo obviously pushing the limit of the vessel’s capacity.

“Crane! Get it over here!” The captain yelled at the dock crew while waving his arms around.

“Look, Dad!” Marie pointed at the harness coming around a large chunk of metallic rock. It had holes and

scrapes all over, yet was shining in the sunlight. “How much does that weigh to make the boat get so low?”

“That mammoth of a rock weighs thousands of pounds. You should look at all of the other pieces too. They are smaller, but they still weigh a lot. They are probably made of iron.”

The crew carefully lifted medium and small pieces of rock out of the boat and onto the waiting trucks. Because of its immensity, the largest piece was loaded on its own truck. Marie saw how careful the crew was to not touch the rock with their bare hands. They wore thick gloves tucked around long-sleeved coats. They looked almost fearful of the rocks and made it clear that they were ready for this job to be over. They had rushed to get the rocks off and kept their conversations brief.

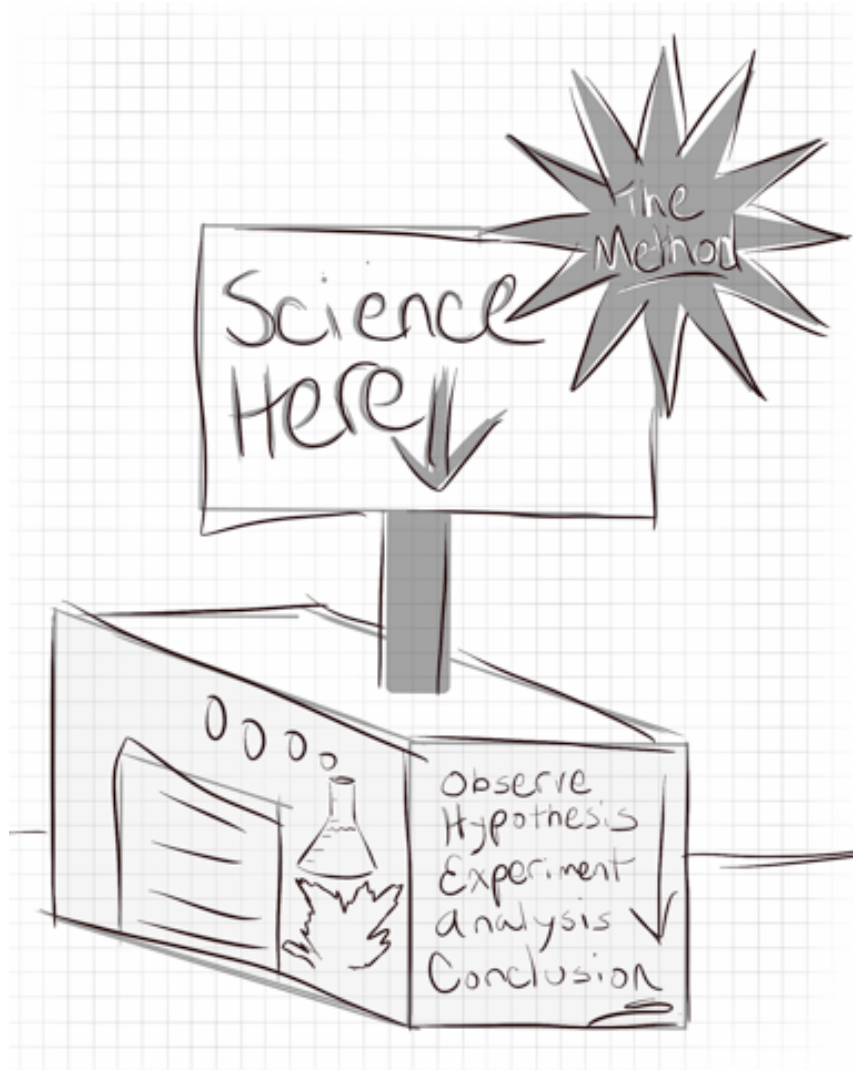
“Why is the boat crew acting so peculiarly?” Marie looked up at her dad.

“I’ll tell you when we get to the lab. It seems we have some investigating to do.”

They hopped onto another truck with some of the smaller pieces in the back and got a ride to a temporary building, also known as the lab. It was a plain grey trailer (similar to a hangar) with a large garage door.

Anyone passing by would have thought that the lab was a storage unit or a garage. But Marie knew that it was full of observation, hypothesis, testing, analyzing and conclusions. She wished the garage had an elaborate sign

indicating the wonders within. She had designed the title of her ideal lab as “The Method” with graffiti outlines and huge tacky stars on a billboard. No one, in Marie’s mind, would be able to resist going in.



The lab's wonder within reminded Marie of herself. She had adventure, excitement and dreams within herself and yet no one would know simply by looking at her. She thought that most people were probably full of mathematical, artistic, and scientific dreams within.

Marie and her dad jumped out of the truck and went into the lab to watch the rocks as they were being unloaded. The largest rock was hard to handle because of its size, but a forklift and straps got it into its place. There were a lot of pieces, but none of them seemed to be the same shape or size.

Marie's intuition was telling her that this was a special find and that she needed to look more closely at everything. Her heart seemed to skip around in her chest and she started to sweat. She edged closer to get a better look and saw two very small pieces that appeared to be the same size.

"You OK, sweetie?" Her mom walked over from an office area and was eyeing the new specimens of rock while she asked. She looked back at Marie. "Sweetie, are you alright?" She could tell that Marie was sensing something.

"I think so. Yeah, I'm alright."

"What is it, Marie?" Her dad touched her clammy brow.

"Remember my story? Remember Atlas? I feel like this is connected."

"Whoa!" Her mom sat down.

“OK, so how?” Her dad took a step back and looked at all the rocks.

“I don’t know yet, but I need to find out.”

Marie’s parents supported her and loved her always. After her last adventure they believed in her, but found that there wasn’t enough evidence to do anything with it. There was often dinner conversation about the dinosaurs of Maneo compared to the findings that her family did on earth.

Marie had written down her story to preserve the memory. She rarely used her wings, because she could only use them when no one was looking. That was hard to do with billions of people on the planet.

Now, a set of metallic rocks sat before this family of scientists. They all felt like these rocks would be significant, just as the Atlas puzzle had been. All three of them drew in a deep breath in perfect synchrony and gazed at the pieces of rock. Marie got up and walked towards the rocks with her hand outstretched.

“Stop!” Her dad snapped out of his reverie and leapt up to stop Marie from touching the rock.

“Why?” Marie was a little flustered. “How can I put pieces together without touching them?”

Her mom stood up and chimed in. “The single meteor broke into all of these pieces when one of the divers touched it. It was almost chemical in nature because there was heat released and a glow. We are worried that if it is

touched again, then another reaction could occur. You might get hurt.”

“OK, so no touching. You used metal straps and metal tables and tools to get them here. The crew wore gloves. Can I poke them with metal if I use gloves?” Marie grabbed a pair of oversized work gloves.

“Yes, you can do that.” Her mom nodded her head. “And just so you know, the rocks seem to only split with human touch. We think there is something about our skin that triggers the reaction.” Her mom was looking at her notes to see if there was any other helpful information.

Her dad added, “A bird landed on a piece on the way over and nothing happened. And, it touched organic material in the water with no issues as well.”

“I’ll be careful when I handle the rocks. They are reactive – got it.” Marie was studying the rocks as she was talking, rather than looking at her parents.

“Marie, I think you have a mystery on your hands again.” Her dad gave her a knowing smile.

Marie took a step towards the rocks and felt her hand warm. She thought of Atlas and asked in her thoughts, “Where are you? Are you there? Are you coming again?”

Another faint warm tingling within her hand responded to her questions. It was a vague feeling of what was to come. She perceived that it was time for her next mission. Taking a deep breath, she started to study the rocks. She held a smaller one in her hand with the oversized glove.

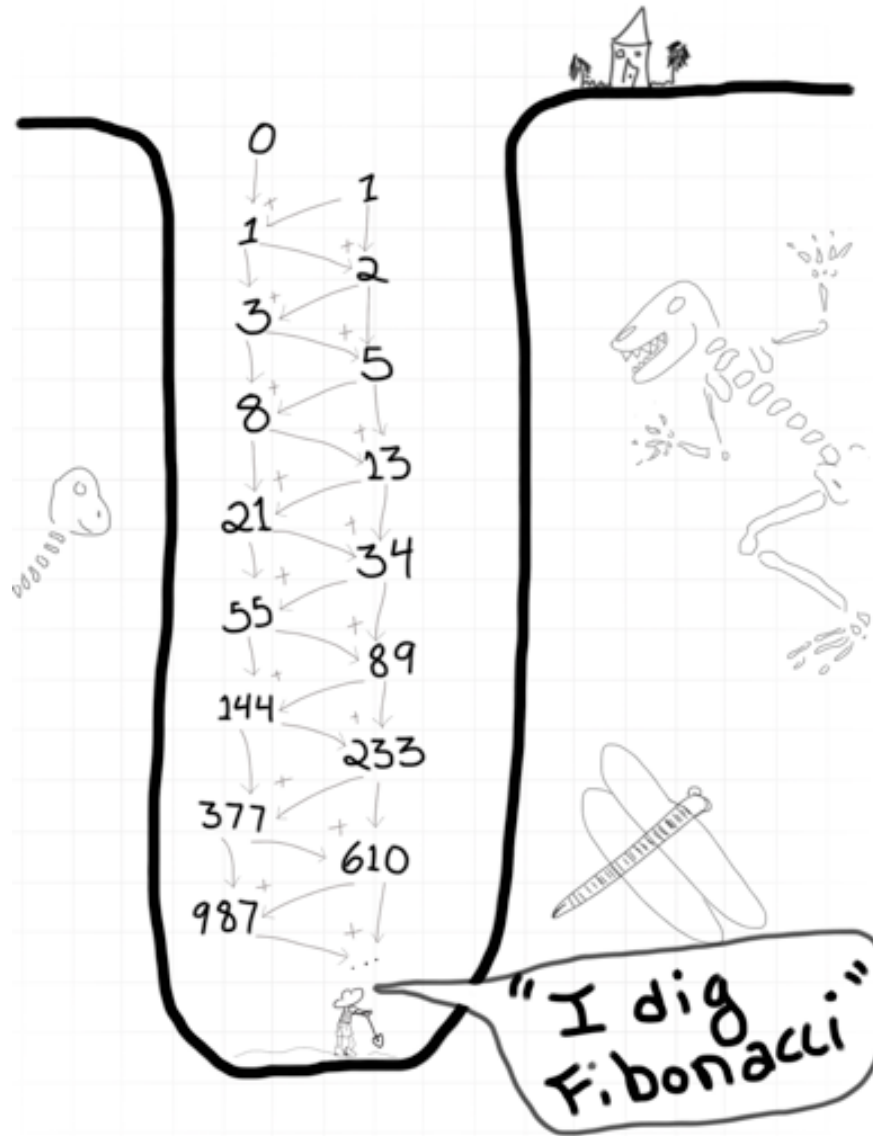
Holding the rocks gave an idea of their weight, but not much more than that.



“How many pieces?” She inquired in excitement.

“Twenty” Her mom responded, as she continued to look at her notes.

“I guess it’s not Fibonacci this time.” Marie sighed. “It was almost a Fibonacci number though, twenty-one would have been.” She flipped back to her old notebook and looked at her illustration from over a year ago.





✱ SPIRALING INTO ADVENTURE ✱

Marie was grateful that the lab was right next door to her home. Only a parking lot stood between the front door of her residence and the garage door of the lab. She was able to take breaks for food and sleep as she needed (or as her parents asked).

She followed her idea of “The Method” laboratory. In the spirit of scientific discovery, she took notes of her observations for each rock. She weighed them, measured their size, studied their material composition, and their magnetism. She had large scales, gaussmeters (for magnetism), and laser imaging to get a three dimensional volume. Marie loved having all of the technology she

needed at her fingertips. She sat down with her notebook and tried to formulate questions that would help her to figure out exactly what kind of puzzle she was dealing with.

She soon found that there was no correlation for volume or shape in the data, but she found that the weights of the pieces were blatantly obvious – Fibonacci.

piece	weight(kg)
1	1
2	1
3	2
4	3
5	5
6	8
7	13
8	21
9	34
10	55
11	89
12	144
13	233
14	377
15	610
16	987
17	1597
18	2584
19	4181
20	6765

Fibonacci

She had an assumption that twenty pieces meant that it wasn't a Fibonacci sequence, but her assumption forgot about zero. "The first number in the sequence is zero and a piece weighing zero kilograms wouldn't be much of a piece at all. Although, it could make the count twenty-one," she thought.

Marie laughed at herself. There were 21 pieces if you assumed one of them was zero. She knew that logically this had flaws, because she could have infinite pieces weighing zero if she allowed it. "Math is fun when you start to make your own rules," she thought while recollecting all the mathematicians that had breakthroughs because they played with and questioned existing rules.

Her hand tingled more as she thought of the correlating weights. She started to feel her wings tingle as well. Excitement was growing within her and she found it hard to concentrate. Because of this, she knew she was on the right track.

"Anything yet?" Her mom brought a bowl of mango slices and some water.

"Yes!" Marie showed her what she had written in her notebook of the weights.

"Wow! That seemed easy." Her mom nibbled on a slice of mango as she talked.

"I know" said Marie, shoveling slices her into her mouth. "Nothing's happening yet. I think it's just the start. My hand is tingling a lot. I feel like I need to touch the

pieces with my bare hands. These gloves are cumbersome and don't let me fully observe.”

“You really shouldn't. I don't want you to have them break into more pieces or for you to get hurt from a reaction. Scientists observe plenty of dangerous objects without touching them. There are chemists who study things that would kill them if they touched them – like some types of mercury. I don't think they would say that they have to touch it in order to observe it.”

Marie's hand tingled more at the thought of touching the fragments of rock. She started to feel an urge to touch them more than ever. Her mother's words seemed to float into the void of Marie's mind that was set aside for ignoring things.

“Mom, I'm going to keep working on this tonight if that's alright.” She didn't want to discuss the issue about touching the rocks anymore.

“Fine with me. Your dad and I are still working on collecting fossils from the other site. Just make sure you rest when you need to.”

“I will try.” Marie glanced away and then back with an intense look into her mom's eyes. “You know I may go on another adventure?”

“You think so?”

“I know it.”

“Promise me you will be safe.”

Marie took a deep breath before she could respond. “I

can't promise that, Mom. I will try to be safe. It was dangerous last time and I doubt it will be risk free if I go again."

"I know."

"It wouldn't have been much of an adventure and I wouldn't have been a hero if there hadn't been any danger or risk involved."

"I know."

"I think, in a way, I was chosen for this. I don't know why, but I need to do this."

"I love you. I know that you will prevail through your tests. Just understand that your dad and I are always with you, especially when you are far away."

"I love you too." Marie wrapped her arms around her mom. She felt loved, trusted, and supported. "Thank you."

"For what?"

"Letting me be me. Letting me do what is calling me."

"Well you're not gone yet. I love you and I will see you in the morning." She kissed her daughter's forehead and headed home.

"Thanks for the mango, too!" Marie shouted as the door closed.

Marie walked around the pieces of rock. Every time she got close to a fragment, she felt her hand being pulled towards it. The two smallest pieces were identical in weight. She laughed at their perfection in measurement. Each

chunk of rock was a perfectly rounded weight in kilograms.

Marie knew that there weren't any coincidences with this puzzle. It was intentionally fractured when someone touched it. There is no way that it could break up so perfectly if it wasn't on purpose. It was meant for her.

"If I could just touch a small piece," Marie whispered, "then maybe it would tell me more."

Marie let her hand come within millimeters of the two smallest rocks. They looked different with all their holes and crags, but each weighed exactly one kilogram.

"I know I shouldn't touch it." Marie thought about her parents' words. Marie remembered how afraid the crew was after touching the rocks. "But, maybe I should."

An instinct from within urged her hand closer. She couldn't resist the pull. She felt like her fingertips were the North Pole and the rocks were the needle on a compass. She gave in and touched the two smallest pieces.

"Oh dear." She saw a reaction starting.

The rocks glowed with an orange and blue luminescence and started to morph into shapes. They slowly flattened out into two small square planes while giving off a lot of gas. They were only a millimeter in width each, like a small fleck of metal. There had been some sort of chemical reaction, but Marie didn't understand. The two squares were as flat as a sheet of paper.

"I guess a lot of the material burned off. These don't weigh close to a kilogram now." Since they were so small,

Marie made sure to place them where they wouldn't get lost.

“They didn't fracture!” She just realized that she was able to touch the others without creating more pieces. She had been afraid that it would make a bigger puzzle for herself if they fractured with each touch.

“Here it goes.” Marie walked around the room touching one piece at a time. She worked from small to big and waited for the full reaction to finish before she moved on to the next. The ceiling fan in the lab sucked the gas up and out as the meteor rocks reacted.

The 2kg rock turned into a 2x2mm square. The 3kg rock turned into a 3x3mm square. The 5kg rock turned into a 5x5mm square. She saw that each rock morphed into a square that was proportional to its original weight. Each square was as thin as paper, but still made of metal. She took out her notebook to start recording her observations.

For each rock she touched, she measured the length. When she got to a piece that would barely fit through the garage door, she decided to drag everything out to the parking lot. The larger squares were like unwieldy sheets of metallic paper. She put on gloves and a hard hat for moving the un-reacted pieces. She climbed up onto the seat of a forklift and turned the key (the larger pieces were very heavy and a forklift was her best option). She had seen the forklift operators use it a million times – she knew the basics.



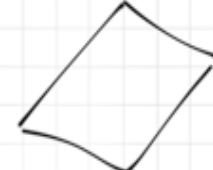
“Thank goodness everyone’s asleep.” She whispered to herself. “And thank goodness for a heavy duty forklift!” She separated the big pieces, anticipating that they would grow to be the same length that they weighed. So a 6,765kg rock would be 6,765 x 6,765mm square.

“The big one would be over 6 meters in length and width! That’s huge.” Marie calculated in her head and tried to place each piece far enough apart with the forklift so they didn’t touch as they reacted.

She climbed out of the forklift, walked around, and continued to tap each piece with her finger and record her observations. They all had the same trend (or pattern) that followed the weight-to-square size relationship. “The weight in kilograms morphs into the length in millimeters!” She drew out a rough sketch of the process in her notebook next to her observations.

$w = \text{weight}$
 $l = \text{length}$
 $w = l$

piece	w(kg)	l(mm)
1	1	1
2	1	1
3	2	2
4	3	3
5	5	5
6	8	8
...

Steps
 rock → 
 +

 =

 ↑
 square

Marie sat in the parking lot staring at the 20 squares in front of her. She felt that her observation had been completed and that it was time to solve the puzzle. She hypothesized that somehow the shapes would fit into each other, but couldn't yet see how.

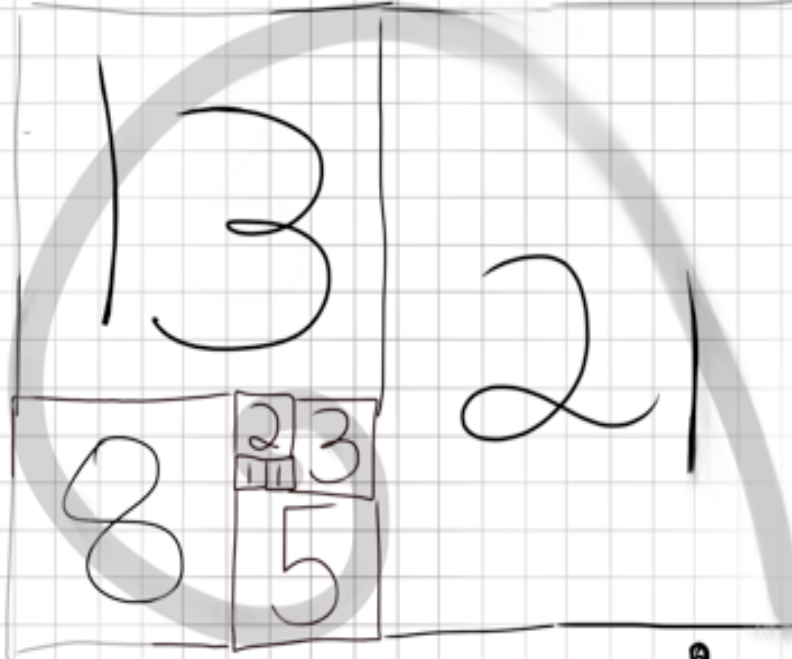
“Well, I might as well start small and experiment with how they fit.” Marie decided to draw different configurations of squares in her notebook to see if anything seemed orderly. She experimented with putting them in rows and squares. She piled them on top of each other and stacked them like stairs.

“Nothing yet.” She flopped down on the ground and looked to the stars. She needed a break. Just last week she had looked at galaxies with her telescope and admired their magnificence. Her mind drifted to that peaceful view. As she daydreamed in the night about spirals of stars, her hand tingled. It gave her the feeling that her daydream was more purposeful than a mere distraction. She sat up suddenly...she realized her daydream was guiding her!

“Spirals?” As she said it her hand glowed and her invisible wings burned with a desire to fly. “Spirals!”

Marie took out her notebook again from her back pocket. She started with the smallest squares in her notebook and carefully arranged them into a beautiful spiral. They fit perfectly in order. She had seen that spiral before. It was The Fibonacci Spiral (an approximation of “The Golden Spiral.”) Her notebook sketch confirmed that she was on the right track. The glow in her hand increased with each pencil stroke.

Shelling out Fibonacci...



Fibonacci
sea snail



“All right! I need to put these squares together in the parking lot.” Marie started arranging the metal squares into the spiral shape from her notebook. The parking lot was a perfect place to do it because it was so large. Luckily, the heaviest piece was no longer so heavy that she couldn’t move it by hand. It had lost most of its mass when it went through its transformation.

Carefully, she made sure that each piece was perfectly aligned. She knew when each square was in its place because it became fused to the previous square. She saw that the material was changing from what seemed like a plain sheet of metal into a material that gave off a colorful array of light.

Every time she placed another square into its place, she gained more of her special vision that allowed her to see many spectrums of light. By the tenth piece she knew that her wings were no longer invisible. She was becoming like Cosmos again. At the nineteenth square, she felt a presence.

“Atlas?”

“YES”

“Oh Atlas! I’ve missed you so much.”

“I MISSED YOU TOO”

“It’s been a long time.”

“NOT TOO LONG,” Atlas glowed in her hand.

“FINISH THIS LAST SQUARE”

“Yes, yes, yes, the last square.” Marie moved the last

piece into alignment and saw it fuse with the rest of the spiral.

“LOOK!”

Marie saw a curved line start at the center, spiraling outward and connecting the corners of the squares. She looked at the page in her notebook and saw that they were the same spiral. She tucked her notebook into her back pocket and looked at the newly formed spiral. It was red hot and started to slowly spin. Marie stepped back and watched the spiral speed into a swirling vortex of light on the surface of the parking lot.

“Well, I experimented and it seems to have worked. Not much analysis here. It seems I can conclude that these pieces fit together.” Marie beamed with her love of problem solving. Atlas beamed right along with her.

With all the commotion, Marie’s mom and dad peeked their heads out of their door and saw Marie at the edge of a red whirlpool. They were in awe. Their daughter’s wings were reflecting the red light, casting a marvelous glow.

Marie knew it was time. The spiral was now spinning so fast that there was no longer a visible spiral line. She could see every wavelength of light being sucked into the vortex. It was time. Time to fly into the light.

“GO” Atlas gently pushed her forward.

“Here we go!” Marie spread her wings and did a swan dive as if off a diving board into the parking lot’s maelstrom. She waved to her mom and dad right before

she crossed the horizon of the swirl and was engulfed in its vortex.

She felt her body turn into a beam of particles and shoot across space and time. She had done this form of travel enough times to know that she was going farther than she had ever gone before.

She opened her eyes as she reconstituted and realized that she was completely submerged in water. Marie had to adjust to not breathing air. No matter how much Atlas assured her that it was OK, she struggled to breath water.

“JUST BREATH”

“I’m trying.” Marie paused and took a deep breath. “Alright. I think I have it down.” Marie had breathed liquid before, but couldn’t seem to get used to it.

“OVER THERE”

“I see it. An ancient wall.”

Marie flew with her wings, like fins, through the water to the wall. She saw symbols etched on the surface of the stone wall that initially seemed jumbled. Her mind quickly adjusted to the symbols before her. They were from the same ancients that had taken part in her last adventure.

She read the ancient language before her:

Again, Cosmos will need to prevail

A Star will be unveiled

*Cosmos again is a team
Together a hero – a light beam
Be a catalyst and find this star
It is near and yet so far*

“Another mission?”

“YES”

“We are ‘Cosmos’ again.” Marie was referring to the name that they were given on their last adventure. When she combined with Atlas they became one – Cosmos.

A big, red, square button stood before them on the wall. Marie’s experience with big red buttons brought up mixed feelings. “I really have a hard time with these sorts of buttons. It doesn’t take much thought to press them, but can result in a whole slew of problems.”

“PRESS IT... PLEASE”

“Really? You remember that pressing a button isn’t always a good idea, right? What if this button causes the whole universe to implode? Or explode? Or freeze? Or get sucked into a mega black hole?” Marie had a suspicious gut feeling about pressing the button and she was clearly stalling.

“PRESS IT”

Marie pressed her hand into the square with much reservation. She became immediately frozen. She felt the wall tremble and yet she could do nothing. Even her

thoughts were slow.

“I...can’t...move...”

“IT WILL BE OK, JUST WAIT”

“For...what? ...I...don’t...seem...to
...have...a...choice.”

“WAIT HERE AND YOU WILL SEE”

“How...long?”

“AS LONG AS IT TAKES”

Atlas fell silent and Marie could no longer think. She was just like a rock – lifeless. She was frozen to the wall, under an ocean, in a far-off galaxy. If she could actually think, she would be horrified.





❁ PROJECTING ❁

Marie came into consciousness in a room void of everything except for three small coins at its center. She took three steps towards them and knelt down to study them better.

“PICK THEM UP”

“How did I get here? I was frozen to the wall.”

“HERE? THERE? DOES IT MATTER?”

“I guess not. I feel a little different. Something is different, but I can’t quite describe it.”

“PROJECTION”

“Projection?”

“WE ARE BEING PROJECTED HERE”

“I don’t understand. What do you mean?”

“UNDERSTANDING WILL COME IN TIME”

“Why can’t you just tell me?”

“YOU WILL BE SHOWN”

“OK, I am getting used to this feeling. It’s odd, I almost feel like I am in a very vivid dream.” Marie felt comforted that Atlas was with her again. “So the coins...we shall have a closer look.”

“PICK THEM UP”

Marie studied them before she scooped the three coins up into her hand. They had circles in different configurations on their surface. Two of them appeared identical.



As Marie touched them with her fingertips, the small circles began to orbit the larger circles on the coins' surfaces. They looked like planets in a solar system.

“What are they?”

“THE PORTAL FOR LODESTAR”

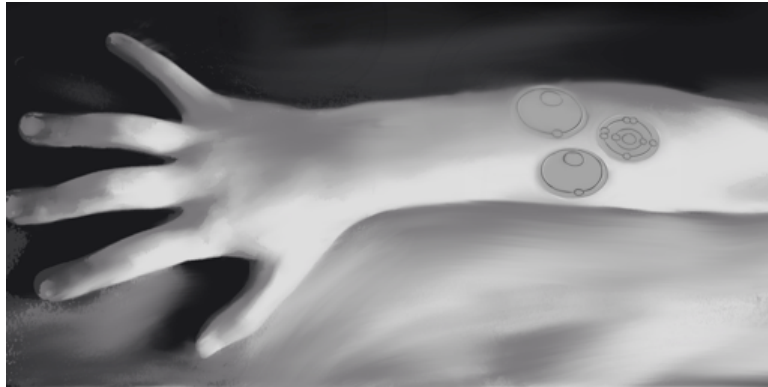
“Lodestar?”

“A COMPASS THAT WE WILL NEED FOR OUR MISSION”

Marie started to feel the coins warm in her hand and get thinner. She froze when they started to move. With calming thoughts, Atlas reassured her that it was ok. The coins started to glide their way from her hand and up her arm. They were so thin that Marie could see through them, like rice paper.

“MERGE”

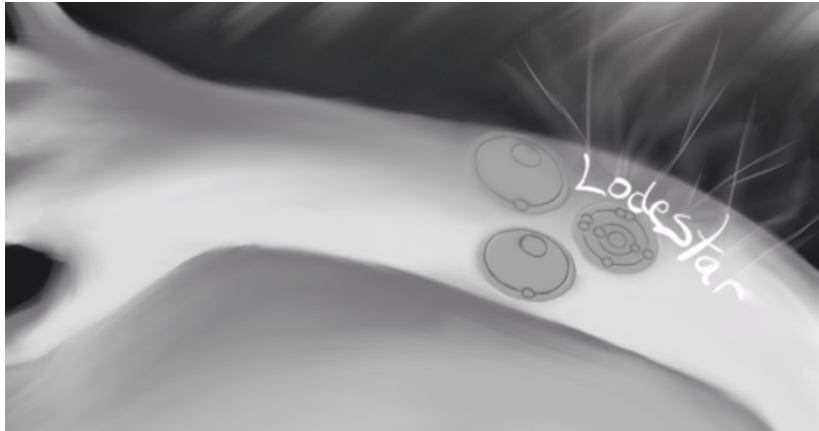
“They are merging into my arm!” Marie felt the coins slowly sink into her skin and become part of her arm. It tingled like a caterpillar on skin.



“THEY ARE STARTING”

Marie watched as little solar-system-like tattoos orbited on her arm. It felt like an invisible warm pen was drawing circles on her arm. They moved faster and faster and started to glow. A word started to appear on her arm. It was shiny and beautiful.

LODESTAR



“WE ALMOST HAVE LODESTAR”

“I feel it.” Marie looked at her arm. Lodestar shined onto the wall of the room and revealed the symbols:

Find the circles' match and put them together

“Circles' match?” Marie didn't understand the directions.

“THE COINS HAVE CIRCLES”

“Yes! They do!” Marie studied them more and noted that one of them had eight orbiting circles and the other two only had one. She noted the numbers in her mind.

“EIGHT AND ONE”

“Yes. I think I will need that observation.”

“WE MUST GO FIND THE MATCH”

“There is a way out of here, right?” Marie looked around and saw only walls, floor and a ceiling.

“JUST WALK THROUGH THE WALL”

“What?” Marie smiled and thought that Atlas was joking.

“NO, REALLY... THROUGH THE WALL”

Marie shrugged her shoulders and slowly walked through the wall. She was surprised that it worked. She laughed and then noticed the same feeling that she had felt before. “I feel like I am dreaming.” She thought.

“NOT DREAMING”

“Yeah, but different.”

“LET'S MOVE ON”

Marie looked around and saw mountains off in the

distance. Atlas pulled her towards the peaks in the distance. Without thinking about it her feet lifted off the ground and she was flying.



Flight was always amazing to Marie. She zoomed up and down and did loops and flips in the air. Adrenaline pumped through her veins with excitement. Marie savored this pure form of freedom.

As Marie approached the mountains, she was directed towards a cave. The cave was high up towards the top of a snowy peak and had jagged edges like the mouth of a shark.

Marie flew right into the dark cave and followed its contours to its depths. She arrived at a pool of water at the far end of the cave. At the base of the pool there were circular symbols in the clear water. They were the same configuration as the ones on her arm. The symbols were glowing in the dark.

“The symbols in the pool match the ones on my arm.” Marie sat down on a rock to study them and contemplate the words that had appeared on the wall. She said the words out loud:

Find the circles' match and put them together

“If the symbols at the bottom of the pool are the same as the ones on my arm, then are they a match?”

“MAYBE”

“Maybe not that easy.” Marie felt like there was more to the words.

“MAYBE SOMETHING MORE”

She stood up and leaned over the pool to see if there were any details she was missing. She didn't feel like the symbols at the bottom of the pool were the full answer. She pondered what the 'match' was, and contemplated the symbols some more.

"These symbols, these circles, are familiar. I know I have seen them before. Where have we seen these symbols?" Marie traced the circles on her arm with her fingertip. "It feels like I just saw these circles days ago, what do they mean?"

"YOU ARE CLOSE"

Marie quieted her thoughts and tried to let the empty space of her mind fill with the answer that she sought. The space in her mind was inexplicably filled with a rhyme. She started to say the little rhyming song she had created when she was memorizing The Periodic Table of Elements in her chemistry studies. She just teeter-tottered between two notes as she rhymed:

Every element has an atomic number

Remember and you won't blunder

It gives the number of protons inside

Deep within they hide

Let's start to name a few:

Hydrogen (H) is one and Helium (He) is two

*Lithium (Li) is three and Beryllium (Be) is four
Boron (B) is five, do you want some more?
Carbon (C) is six and Nitrogen (N) seven,
Oxygen (O) is eight and is twenty percent of our
heavens,
Fluorine (F) is nine and Neon (Ne) is ten*

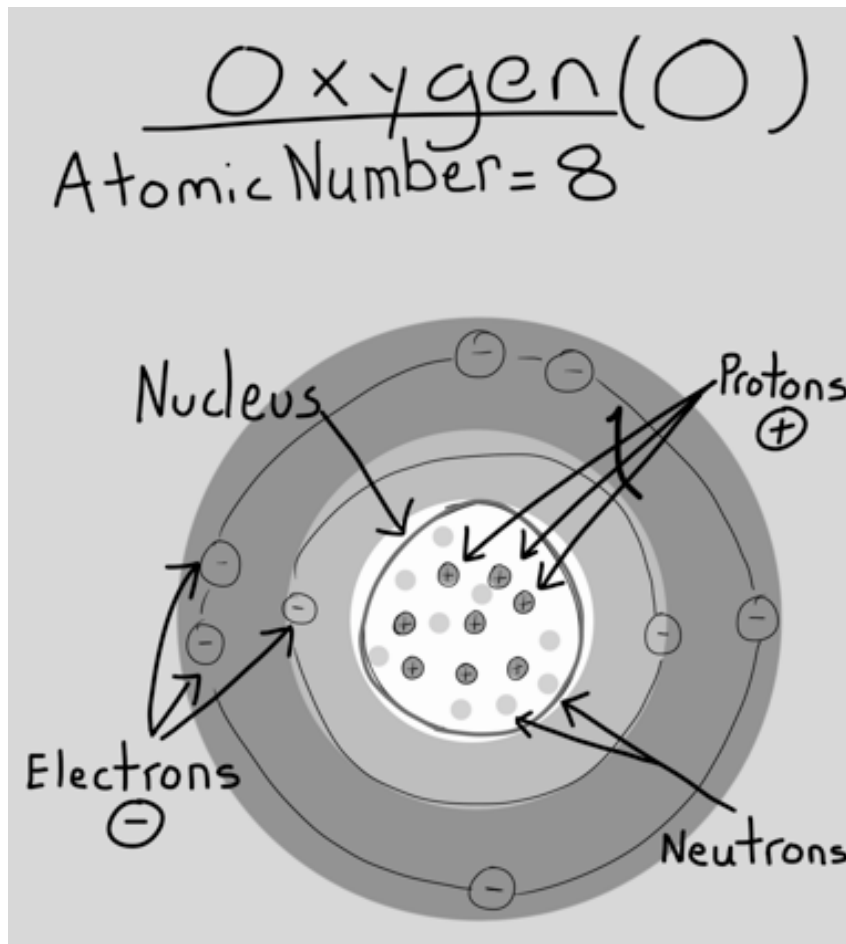
...

“Wait! Oxygen is eight!”

“EIGHT AND ONE”

“Yes! Eight!” Marie got excited as her thoughts flowed. “Eight circles around the unique coin...electrons! They are electrons! So that means eight protons, which means that it’s Oxygen! The atomic number of Oxygen is eight.”

Marie grabbed her notebook from her pocket and opened it to one of her atomic sketches. She had a sketch for many of the atoms in The Periodic Table.



Marie felt reassured that she was on the right path to understanding the directions from the symbols. “Oxygen makes sense, so...”

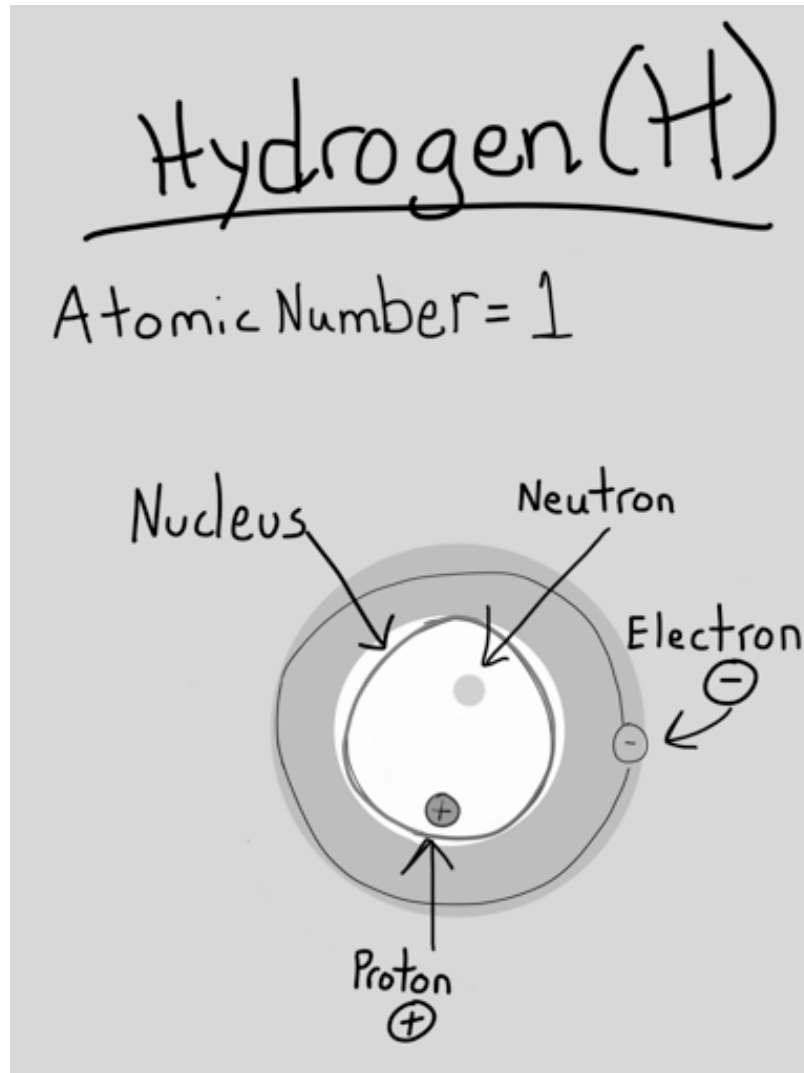
“AND ONE?” Atlas reminded Marie of the other two coins that had only had one electron.

“Yes, that means that the other two are Hydrogen. Hydrogen has one electron and one proton. Its atomic number is one.” Marie got excited thinking of the elements

that made up the matter of the universe.

“YES. HYDROGEN”

Marie flipped back a few pages to her sketch of Hydrogen. She loved drawing atoms.



A smile slowly grew from the corners of Marie's mouth as she realized what the three atoms meant. "We know what this is... it's water. A water molecule is a group of three atoms – Oxygen and two Hydrogen. It's dihydrogen monoxide, also known as H₂O."

"WATER...YES"

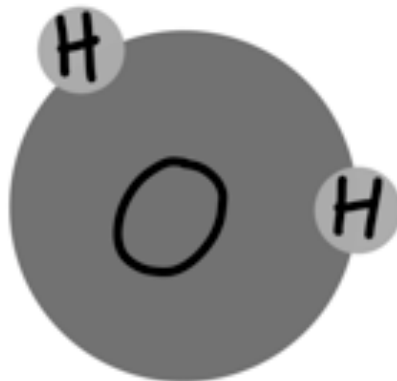
"Water!" The Lodestar on her arm glowed as she said the word. She felt a sudden change in her eyesight. She was used to seeing all the spectrums of light, but now something was even more incredible.

"ZOOM"

"Yes...you feel it too...I can zoom in." Marie focused her eyes on the pool and realized that her eyes had become magical magnifiers. She was able to zoom into the pool and see the water at the atomic level. Mesmerized, she studied the molecules in the pool. There was nothing but H₂O.

"PURE"

"It's pure water - incredible."



Instinctively, Marie dipped her arm with Lodestar into the pool to match the circles to their respective elements. The cave shook and the circles at the base of the pool started to spin. A hole formed and started to suck all the water down into it. There was a whirlpool before her. Lodestar pulled her towards it.

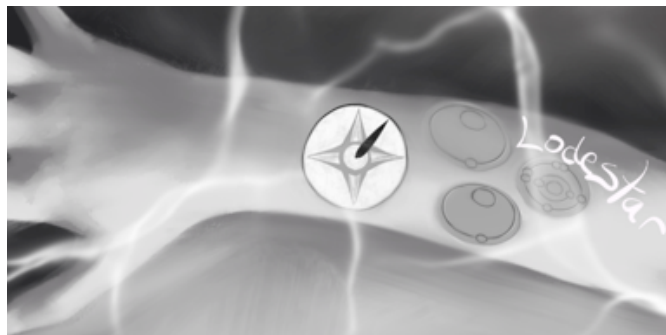
“JUMP”

Marie jumped into the whirlpool. Instantly, she was stretched into a beam of particles and shot across space and time. Galaxies, stars, and nebulas raced past her. It seemed to be similar to what she had experienced before, but yet she still felt that there was a more dream-like quality to it.

She reconstituted and found herself in yet another underwater setting. She took a second to get used to being underwater again.

“WE HAVE LODESTAR NOW”

Marie looked down at her arm and saw that a compass had appeared.





✧ PURITY ✧

“THE COMPASS WILL PROVIDE DIRECTION
IN THIS ADVENTURE”

“I feel the compass is pointing within my mind. I feel
like a bird being guided south for the season.”

“YES...WE MUST FOLLOW”

“It’s guiding me to the right.”

“LET’S GO”

Marie swam with her wings through the water in the
direction that Lodestar pointed. Nothing but sand was
below her and water was all around her. The landscape of

sand and water went on as far as she could see in a vast plane. She approached a smooth area of the sand and landed where Lodestar directed her.

“HERE WE LEARN OUR MISSION”

“I see symbols. I wonder if this adventure is going to be another epic story?”

“MAYBE”

Marie got down on her knees to study the symbols. They were etched into a sandstone surface:

In depths a sickness has caused deep slumber

All life is in hiding until a cure

Five tests of virtue, elements and number

Cosmos must be a catalyst and endure

Purity

Patience

Gentleness

Generosity

Unity

“Elements? In the last story those were wind and fire and water, and...” Marie was thinking of her tests when she met Atlas.

“THINK NEW”

“Right,...Maybe they are elements like Hydrogen and Helium and Nitrogen and Oxygen.” Marie wondered if the elements were literally the elements that made up matter.

“MAYBE”

Marie read the inscription again and thought about the virtues that were listed. “Purity, Patience, Gentleness, Generosity, and Unity...”

“PURITY” Atlas highlighted the first test.

Lodestar pointed to a depression in the sand next to the inscription. Marie swished her hand over it through the water. The currents she made with her motion moved the sand away from the depression and revealed a box. Marie picked up the small box and brushed the remaining sand off the lid.

“It says ‘Purity’ and it looks like there is a lock to open the lid.”

“FIND THE KEY”

Marie looked around the sand where she had found the box and started to sift her fingers through it. She dug a little deeper until the tip of her pinky brushed against a hard object.

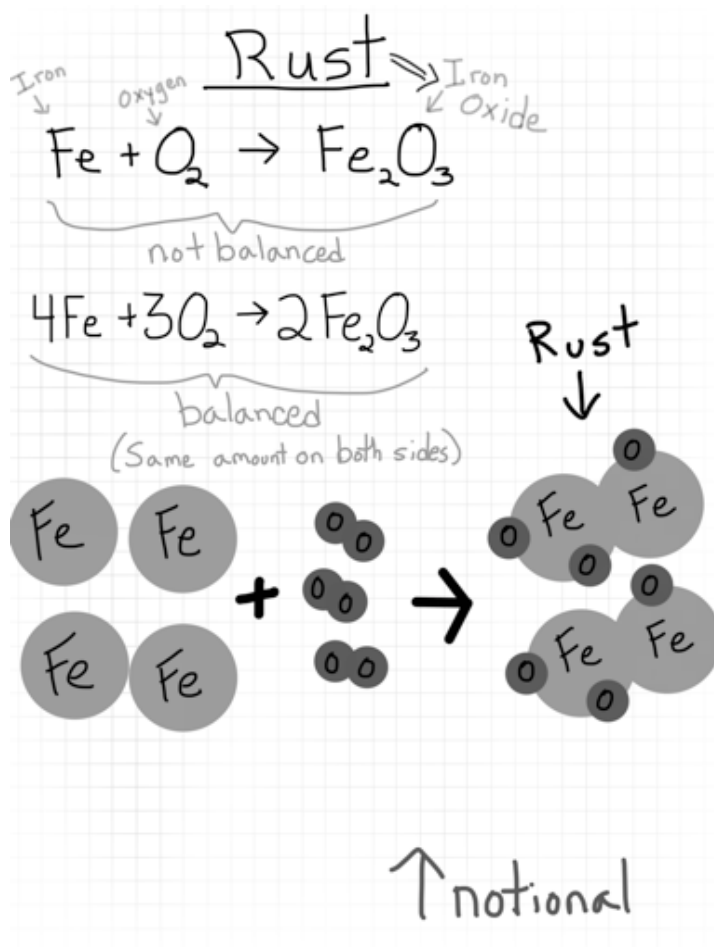
“The key!” Marie said as she picked up a key.

“BE CAREFUL”

Marie noticed that the key was fragile. It was rusted and brittle. “I don’t think it is strong enough to work.”

“IT MUST BECOME PURE”

Marie thought about Atlas’s idea of Purity. She thought about the rust. “Well, rust is kind of like impure Iron (Fe). It is Iron(Fe) that has been combined with Oxygen(O). Rust is oxidized Iron.” Marie sketched the chemical equation for rust in her notebook.



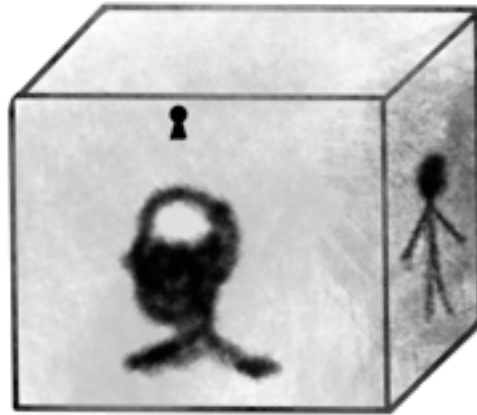
Then she carefully flipped the key in her hand to see if there were any details to it. She didn't see anything that would help her.

“THE BOX”

Marie looked at the box again and noticed faint symbols rusted into the sides. Each side had a single word. Marie read the four sides, “Mind, Body, Tongue, Actions.”

“A PUZZLE”

“OK, so mind, body, tongue and actions...What does that mean?” Marie contemplated.



“PURITY”

Marie pondered how mind, body, tongue and actions related to purity. She knelt down on the sand and meditated on that idea. “Purity is kind of like cleanliness. Pure water would only have H₂O, and pure Iron wouldn't have any rust, and...”

“THINK MORE DEEPLY”

“Yeah, my character, me, ...how am I pure? How can anyone be pure?”

Marie meditated more on the words on the box and realized that she needed examples for each side. She needed to find a form of purity that matched each side.

“WE ARE ON THE RIGHT TRACK”

“OK, so mind...” Marie started to think about her mind’s purity. Clean thoughts came to mind. She started to think about what impurities would look like. “Judging, gossip, negativity, envy, ... those wouldn’t be very clean thoughts.” Marie thought more about purity of mind.

“PURE THOUGHTS”

“That’s what I was thinking. I might have thoughts that aren’t very nice sometimes, but I can choose to dwell on them, or push them from my mind.”

“YES, GIVE THAT TO THE BOX”

Marie realized what the box needed. She pressed her hand into the side that said ‘Mind’ and meditated on the Purity of mind. She contemplated thoughts that were constructive, loving, and unifying. She thought of replacing disturbing thoughts with peaceful thoughts. She thought of replacing angry or hateful thoughts with thoughts of love.

Slowly the side of the box illuminated and transformed from a rusty appearance to a sleek metal. Marie saw the transformation and moved her hand to the next side.

“BODY”

Marie focused on a pure body. She pushed her thoughts into the box: “Eating healthy and clean, exercising, breathing deep, sleeping, bathing, going to the doctor ...” Images of avoiding chemicals, washing her face, and breathing fresh air all came into her mind. The side of the box that said ‘Body’ also transformed from rusty to clean metal.

“TONGUE”

“My tongue?” Marie thought that it couldn’t just be a tongue in the literal sense. “Words?”

“WORDS”

“Yes, Purity of words.” Marie meditated on purity of words. She thought about how her words often affected the people around her. Kind, helpful, loving words did good. Backbiting, angry, hurtful words did not.

“WORDS”

Marie pushed the thoughts of pure words into the side of the box. She thought of speaking the truth, speaking from necessity, speaking with tact and kindness, and speaking gently. Then, the third side transformed.

“ACTIONS”

“Pure actions...” Marie focused on her actions in her life and what pure actions were. She meditated and when she felt like she had the answer, she pressed her hand into the last side of the box. She pushed thoughts of pure actions. They were actions and deeds that enriched, enlightened, aided, and comforted others. She thought of

healing action, justice in action, and standing up for what is right and good.

“LOOK”

Marie saw that the fourth side was now transformed. The lid and the base transformed with the fourth side such that the box looked new and shiny.

“The key is still rusty.” Marie was puzzled as to why the last side didn’t purify the key from its rust.

“YOU MUST PURIFY IT”

“Huh?”

“ZOOM”

Marie used her new ability to zoom her vision into the key. She saw that the Iron (Fe) had been bonded with Oxygen (O).

"I can see that Oxygen is combined with Iron, but how do I remove it? I don't have a steel plant with which to do reduction reaction or to process it! The key wouldn't even be in key form if I could use common methods for removing Oxygen from Iron."

“MEDITATE”

Marie listened to Atlas’s words in her mind and started to see that she could move the atoms with her mind. She focused as hard as she could on one Oxygen atom. The atom budged a little.

“FOCUS”

“I’m trying.” Marie focused just a little more and,

miraculously, the atom moved away from the Iron. She pushed the Oxygen atom out of the key and into the water around her.

“GOOD”

“There are a lot of molecules here.”

“YOU CAN DO IT. PRACTICE”

Marie focused one by one and pushed each Oxygen away from the Iron. As she moved from one to the next, the process got faster. Eventually, the key was pure.

“NOW”

Marie took the key and unlocked the box. It immediately burst from within and became a flat sheet of metal. She jumped away with the burst and waited a moment to make sure that the box’s transformation was over.

“MORE CHALLENGE”

Marie looked at the metal and saw that there was an inscription:

Purity has been met

Now for a mathematical set:

Create the recursive Tree : 1, 2, 4, 8, 16, 32

Six iterations it will be

Give it growth by adding your element six, from these gems you must pick.

As Marie read the inscription, six gemstones appeared in the sand next to the inscription.



* THE TREE *

Marie read the symbols again “*Create the recursive Tree : 1, 2, 4, 8, 16, 32...Six iterations it will be.*” She wondered if the tree was connected to her previous adventure with Atlas. In that adventure, the trees were decision trees (trees that showed her how her decisions could have ended.) She asked herself: “Tree, I wonder if it is a decision tree? It says that it is recursive, though, and that wouldn’t work.”

“NO” Atlas responded to Marie’s thoughts.

“OK, so can I safely assume that this is a whole new adventure - should I be open to all types of trees?”

“YES. THIS IS A NEW MISSION. SEPARATE”

“Good. That helps.”

Marie looked at her surroundings of sand and water. She zoomed into the water to look at the molecules of H_2O and found that there were a lot of other atoms mixed in that weren't Hydrogen or Oxygen.

“IMPURITIES”

“Yeah, this water has a lot of impurities.”

“BACK TO THE TREE”

“The tree...recursive...iterations...” Marie thought to herself, as she tried to brainstorm a tree that would meet the challenge. She glanced down at the sand and saw a place to input the tree. “So we know *where* to draw the tree, but we have no idea what the tree is.”

“YOU WILL”

Marie read the symbols again:

Create the recursive Tree : 1, 2, 4, 8, 16, 32

Six iterations it will be

‘Recursive’ and ‘iterations’ were words she had just been reading about before this whole adventure began. She had recently become fascinated with fractals in her mathematical studies. Now she was wondering if they were part of this adventure.

“YOU MIGHT BE ON TO SOMETHING”

“Really? Oh, good! I love fractals.”

Thinking aloud, “Recursive means repetition of a pattern, number, shape, or other item. An iteration is each one of those repetitions. A fractal is made up of recursive shapes that repeat for infinite iterations – they are self-similar. Trees are natural fractals. Ferns’ leaves are another fractal-like example. Ice crystals forming on a surface, and broccoli crowns all have fractal resemblance.” Marie thought out loud and cultivated her feelings that fractals were part of this test.

“DRAFT IDEAS”

“Atlas, that’s a great idea. Let me see what ideas I can draft in my notebook.” Marie opened her notebook and started drawing fractal trees. At first she just drew a normal tree, an oak tree, to warm up her mind.

“NUMBERS”

Marie looked at the numbers on the inscription and realized that they could be branches coming from her tree. “1, 2, 4, 8, 16, 32” She thought in her mind as she drew a tree that branched out in a pattern that agreed with the numbers. “I think I have a tree.”

“TRY IT”

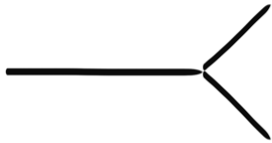
Marie took a deep breath. She had been reading about fractals a lot in the past weeks, but it still felt like a new subject to her. She remembered the many types of trees in her books. There were even three-dimensional fractal trees she could see on a computer. She slowly traced the tree design into the sand.

The sand felt like sand, but didn't act like sand. Each stroke of her finger made a perfect line that looked like ink on parchment paper. She started with just a single line for the number one. That line was then copied twice for branches. Then those branches were copied, and so on. Each copy was an iteration of the previous one, but smaller.

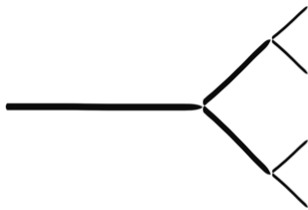
Marie followed the numbers from the inscription: 1, 2, 4, 8, 16, 32.



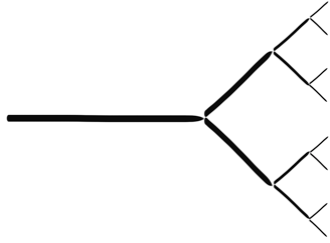
One



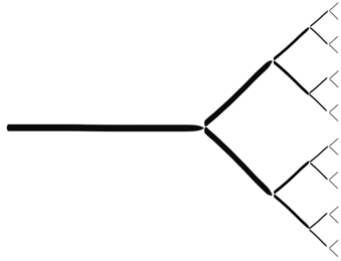
Two



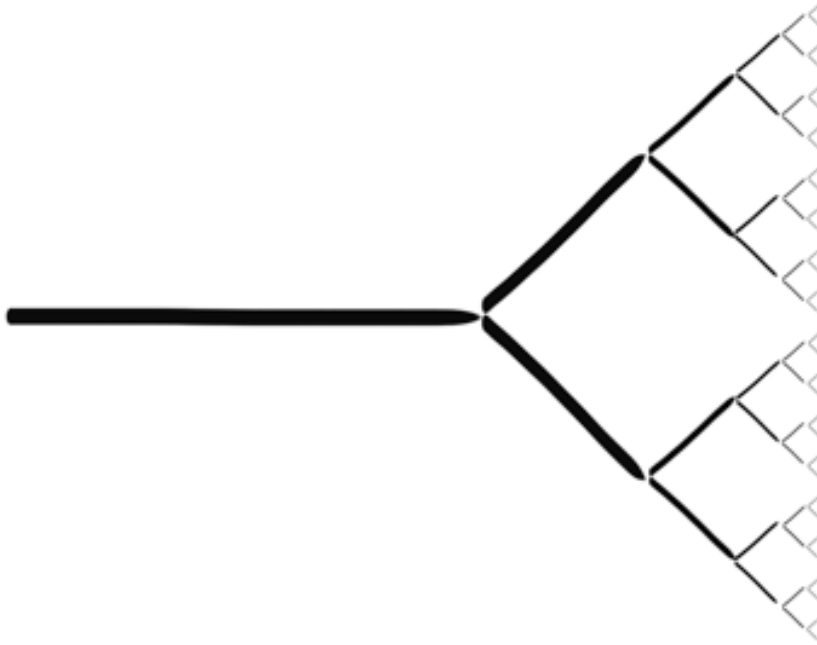
Four



Eight



Sixteen



Thirty-Two

“Now that’s a tree!” Marie smiled at her tree.

“PROMPT”

Marie looked down next to the tree and saw what looked to be a computer prompt. It was a small screen the size of her notebook with a white background and black text. It said:

>>>Input function for number sequence.

>>>Input will be iterations.

>>>Output will be number sequence.

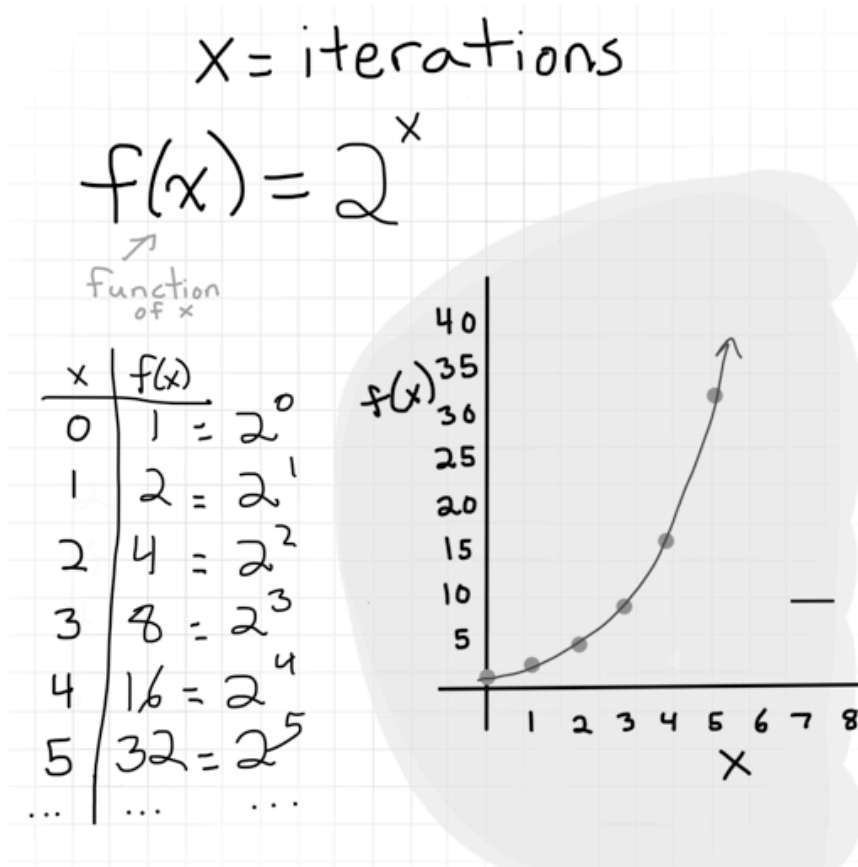
“Wait...” Marie was surprised that there was a computer prompting her for input. “Is this a computer? Am I dreaming?”

“YES, COMPUTER”

The tree seemed to be slowly fading into the sand as Marie stared at the computer screen prompting her for an input.

“HURRY”

Marie looked at the tree and realized that she needed to think fast. She thought about functions. A function has an input (domain) and an output (range). She took out her notebook and wrote down the function for the tree that she had created.



“So I know that this function is an exponential function. It’s $f(x) = 2^x$.” Marie looked at the fading tree and the computer again. “How do I put it in? I only know Python programming! How do I know what language this computer speaks?”

“TRY PYTHON”

“The tree is fading – I’ll try.” Marie started typing in a python function. It was a computer code that would allow a user to input the number of iterations and the computer

would output the sequence of branches for the tree:

```
str1 = input('Input number of
iterations: ')
num1 = float(str1)
i = 0
while i < num1:
    fx = 2**i
    print(str(fx))
    i = i + 1
```

The tree stopped fading and Marie's function was accepted by the computer prompt. She took a deep breath and looked at her tree again.

“IT WORKED”

“I get it now. There were six iterations that I drew, but a real fractal goes on forever. The branches would just keep getting smaller and smaller with each iteration. The computer function must have input all the branches that would have been too small for us to draw.”

“YES”

“I love fractals!” Marie smiled and looked down at the gems that were next to the inscription. She looked over to the inscription and read the second half again:

*Give it growth by adding your element six, from these
gems you must pick.*

“Element six?”

“SIX”

Marie looked at the gems with enthusiasm. She had enjoyed the tree exercise. The gems scintillated in the underwater light in a way that reminded her of the warm sunshine on her face at home.

“Six” she thought in repetition. “Six, six, six, what is the element six?” After dwelling on six for a few minutes, she got sidetracked and surveyed the water around her. When she focused, she could see all of the atoms. It was infinite and mesmerizing. She got lost looking at the H₂O and all the different impurities mixed throughout. “Super magnifying vision can be distracting,” Marie thought.

“GEMS” Atlas reminded her.

“Gems? Oh right, gems.” Marie laughed at herself for getting distracted with her vision. She felt Atlas laugh along with her in her mind.

Marie stared into the gems with her zooming ability. The first five of them were molecules or compounds of multiple elements. The sixth gem was the only one made of a single type of element. It was made of pure Carbon.

Carbon was a very familiar element to Marie. Its atomic number is six (it has six protons). Life on Earth is

considered “Carbon-based life.” Humans, animals, plants, and trees all have an abundance of Carbon.

Marie reread the words on the metal:

...

*Give it growth by adding your element six,
from these gems you must pick.*

“SIX. ELEMENT SIX”

“I think it is the diamond. It’s pure Carbon, which has an atomic number of six. Carbon Dioxide is what trees breathe, I think that my fractal tree will ‘grow’ with the diamond. The molecular structure even looks like a 3-D fractal tree!”

“YES”

Marie gently touched the tip of the diamond with her fingertip. The diamond released itself from the ground and started to float in the water. It was sucking in Carbon atoms that had been impurities in the water. The diamond started to grow.

Marie watched the water become more pure around her. All of the Carbon seemed to disappear from the water. The other gems sucked in other impurities as well. Soon all of the water was pure (only H₂O).

The diamond glowed with the whitest of light when the water became pure. Marie held her breath as the diamond started to sink down into her tree in the sand. She knew

something was going to happen.

The diamond drilled itself down until only a small piece of the tip was above the ground. Marie's tree was undisturbed by the diamond's submersion, except for a small gleam of diamond on its trunk.



A bubble formed at the tip of the diamond and started to grow. It got twice as big with each growth spurt and soon Marie was engulfed within the bubble. She realized that it wasn't just the bubble growing, but the tree and the diamond tip as well.

“Wow, the tree and bubble and diamond have grown... actually, everything is getting bigger!”

“THINK AGAIN”

“What?” Marie looked around.

“GROW OR SHRINK?”

“Shrink?” Marie stood silent and studied her surroundings. Everything looked magnified. “All of the

atoms that I see when I focus are much easier to see now. I think we are significantly smaller...”

“WE SHRUNK”

“Wow! We shrunk a lot!” Marie started to calculate how much she had contracted in size. “The tree trunk was about five millimeters across when I drew it.”

“YES”

“And now it’s five meters across...There are a thousand millimeters in a single meter...so that means...”

“A THOUSAND TIMES SMALLER”

Marie repeated Atlas, “You realize that we are a thousand times smaller right now?”

“YES”

“That means that I am a little over a millimeter tall.” Marie had more thoughts flowing as the concept solidified in her mind, “And the length of a millimeter here is actually a micrometer! It’s a thousandth of a millimeter.”

At the top of the diamond there was a beam of light. Lodestar pointed straight towards it. Marie flew to the light and saw the portal to her next test. The tip of the diamond opened up into eddies of brightness. Another vortex stood before her.

“More spirals!” Marie smiled. “There are symbols too – here on the edge.”

“PATIENCE”

“Patience, patience, patience, patience, patience...” She

read the symbols that repeated around the portal.

Marie jumped into the swirling light and felt herself stretched into a beam of particles. This movement was different than the other times that she had travelled. Rather than light and stars whirling by, this time there seemed to be mostly darkness, with vague forms of energy.

Her particle transport ended in a dark place that felt almost cave-like. There were two forms of glowing light there in the darkness. The first was from Lodestar - the compass gave off a faint green glow. The second was a pool of fluid almost twenty-five meters away. It was glowing with a white light.

“LODESTAR”

Marie looked at the compass and saw that it was pointing to the pool. Proceeding slowly, she could hear her breath in the silence. Her feet made no sound on the soft mossy ground. There were no stars, only darkness. It was the type of darkness that swallows everything. Marie stuck her hand out and watched it disappear into the dark. She quickly pulled it back in close to her.

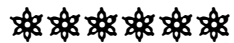
Marie’s heart was beating faster. She felt Atlas forewarning her that the next test might be hard. She swallowed the lump in her throat that seemed to keep creeping up.

“PATIENCE. WE CAN DO THIS.” Atlas comforted her.

Marie’s wings reflected some of the light as she

approached the glowing pool. Within the waters, she could see symbols at the bottom and knew it was the beginning of the Patience challenge.





❖ PATIENCE ❖

The pool steamed up in the darkness with a glowing light. It was a warm water-like vapor compared to the cool dry air around her. Marie thought of the ocean fog from where she had come. The steam was rising in feathery clouds. The pool was pure and clear all the way to the bottom.

The steam from the pool was light and welcoming at first, but as Marie breathed it in, she became increasingly uncomfortable. It acted like a potion that made her irritable. Marie felt the irritation, but was not yet fully aware that the source of her irritation was the vapor.

“It looks like it’s about ten feet down.” Marie thought

of swimming in a pool and how familiar the distance was. She tried to read the symbols at the bottom, thinking “I can’t make out the symbols from up here. I’ll go down and check it out.” As the words left her mouth, she realized she didn’t really want to get into the pool.

“NO.”

“I don’t feel good about it. I just don’t know what else to do.”

“DON’T GET IN”

“Yeah, I agree. There is something about this pool. We need to be cautious.” Marie took a step back. “Maybe I can see what the fluid is in the pool.”

“YOU CAN TRY”

Marie zoomed into the pool and tried to look at each molecule as it moved around, but found it difficult to focus. The vapor was affecting her ability to zoom into the pool.

“NOT GOING TO WORK”

“I know!” Marie snapped at Atlas in irritation. She was having a hard time focusing on the atoms and was frustrated. Atlas was silent. Marie felt the silence and regretted her words. “I’m sorry. I don’t know why I snapped.”

“PATIENCE”

Marie was still feeling irritated so she sat down to meditate and gather her thoughts. As she sat there, a single feather dislodged from one of her wings and slowly drifted

into the vapor. Marie watched the feather fall in perfect circles towards the pool. The feather fell with a geometrical flight that made Marie feel like there was an invisible hand painting with it.

“It feels like this feather is part of the test.”

“MAYBE”



The brilliantly colored feather floated on the surface with little motion after its fall. Marie watched it move with

a slight twirl as she breathed out. The feather started to very slowly change in form. It seemed to be struggling to keep its defined barbs.

“What’s happening?”

“WAIT”

“Yeah, I think I will have to wait and see. Whatever is happening to the feather, is happening very slowly.”

Marie stared and stared at the feather. Minutes turned into hours and the hours felt like days. This time next to the pool gave her time to think. She realized that this adventure was different from her last. She still had Atlas, but this one had different tests and seemed to incorporate knowledge of atoms. She pondered the words that appeared about her mission. “I know that the mission says to find a cure, but a cure for whom or what? What is this deep slumber? And it said there is hope – doesn’t hope have to come from a person or some conscious being?”

“WE WILL FIND OUT”

Marie sat in silence again and watched the feather slowly transform. As she sat, she noticed the same feeling she had before that she was... different somehow. She thought of what Atlas had said when she first felt it – “projecting.”

“PROJECTING”

“What does that mean? I feel like I am still in a vivid dream still.”

“YOU WILL SEE”

Marie was about to ask Atlas more questions, but was distracted by the change of the feather on the surface of the pool. The feather had flattened out. The areas of the feather that were touching the pool had become very dark. Marie took a deep breath and blew at the feather to get it to move.

“It’s like jelly. Wait, no, it’s more like slime!” She said as she watched the feather move in its new state.

“YES, LIKE SLIME. DISSOLVING?”

“Yes! It looks like it is dissolving. It looks just like...just like...” Marie paused. She suddenly realized what the pool was made of.

“YOU ARE RIGHT. YOU KNOW WHAT IT IS”

“Atlas,” Marie stood up and took a step back, “it’s, it’s, ... it’s acid.”

“ACID. STRONG ACID”

There was a change in the air around Marie and it felt like a veil was being lifted from her vision. She had been patient and now knew that she could zoom into the pool to see what it was made of.

“ZOOM”

Marie focused on the molecules of the acid and saw that it was an acid made from two types of elements. “I know what it is. It is Hydrochloric Acid (HCL). There are molecules made from a single Hydrogen atom and a single Chlorine atom. This pool is full of Hydrochloric Acid! I don’t think it gets much stronger than this. My feather

must not be very reactive, because I think this stuff would dissolve just about anything.”

“HCL” Atlas thought to Marie.

Then, for a few quick seconds, the pool started quaking from within. Marie looked at the bottom and saw that the symbols were still unreadable. She then looked up above the pool and saw a circular platform lowering down from high above. It moved downward like an elevator in slow motion until it came to within a couple of inches above the surface of the pool.

Marie flew onto the platform. When her foot touched its stone surface, a small table started to form from the stone. It looked like clay being molded by invisible hands. Marie watched as shelves formed on the table and jars started to appear on the shelf. Each jar was set into its own intricately created cubby. She felt that the whole creation of the table was very dreamlike.

“READ”

Marie saw that there were symbols on each jar. She walked over to the table and saw that each jar had an element within. They were organized by their atomic number in the same way The Periodic Table of Elements is organized. Marie zoomed in with her vision and saw each element’s atomic structure.

“It is so amazing! I feel like an astronaut in a ship staring at a billion star systems.”

1 H															2 He	
3 Li	4 Be														5 Ne	
11 Na	12 Mg														18 Ar	
19 K	20 Ca														36 Kr	
37 Rb	38 Sr														54 Xe	
55 Cs	56 Ba														86 Rn	
87 Fr	88 Ra														118 Uuo	
		13 Sc	14 Ti	15 V	16 Cr	17 Mn	18 Fe	19 Co	20 Ni	21 Cu	22 Zn	23 Ga	24 Al	25 B	26 C	
		39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Ga	51 Si	52 B	
			72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	
			104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Uut	114 Fl	115 Uup	116 Lv	
																118 Uuo
		57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
		89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

Next to the table was another set of symbols inscribed into the stone platform. Marie read:

*To make one, you must take one
With an element and an acid you will make one
The element is related to your past, future and present
After the first choice your choosing is spent*

*The element's positive is prime in value
The element is metallic and non-flammable too
Radioactive it is not
Don't touch the ones that are hot*

*You must be patient with the foggy weather
Just as you were patient with the feather
A trial of element, numbers and virtue
This is your test number two*

Marie read the symbols again and tried to decipher their meaning. She started thinking about what elements would easily react with an acid. She remembered that

metals react with acids to release Hydrogen (H) and salt.

“PAST, FUTURE, PRESENT”

“Yes, what is in the past, future, and present? I can’t speak to the future.”

“PAST?”

“Maybe Fibonacci?” Marie thought of the Fibonacci test that started her first adventure with Atlas and the puzzle with the meteor that was part of her present adventure. She took a deep breath and looked at the elements. She became distracted as she zoomed into them and breathed the vapor rising from the pool.

“FIBONACCI”

Marie didn’t respond to Atlas and was feeling irritable as the vapor’s effects penetrated her mood. She was busy focusing on the elements.

“FIBONACCI? PAST?” Atlas gently nudged Marie to focus on the puzzle at hand.

Marie was unresponsive.

“PRESENT? FIBONACCI?”

“Give me a second!” Marie snapped.

Atlas was silent.

“Atlas?” Marie realized that she had just been very impatient and was feeling irritable again. Atlas was silent. Marie became even more frustrated. The Lodestar compass started spinning and Marie felt dizzy. She started losing her balance as the room seemed to spin around her. The vapor

appeared to create fumes of discontent. Marie stumbled closer to the edge of the pool of acid. She was extremely disoriented.

“SIT DOWN!” Atlas was trying to keep Marie from falling in.

Marie felt the danger and immediately sat down. As she sat she started to assess herself. She had been tested before. In order to be successful in her previous adventures she had to be peaceful, detached, steadfast, and courageous. She didn’t know why she was so aggravated, but knew she had to focus on peaceful, calming thoughts. She thought of patience and how she needed to be patient with Atlas, patient with herself, and patient through the test. As she thought about patience she started to feel guilty for snapping at Atlas.

“I’m sorry. I don’t know why I am acting like this. This is not me. I will be patient, Atlas. Please forgive me.”

“FORGIVEN”

“I don’t know why I wasn’t listening to you.” Marie shook off the dizziness and saw that the compass was no longer spinning. “What did you ask?”

“FIBONACCI IN THE PRESENT?”

“Is there Fibonacci in the present? Hmmm...” Marie knew that there was Fibonacci in the meteor. Then she started to think about the water test. The numbers one and eight were also Fibonacci Numbers. “Yes! Let’s assume Fibonacci Numbers have something to do with this test.”

“ELEMENT IS RELATED”

Marie read the words, “*The element is related to your past, future and present.*”

“YES”

“OK, Let’s break down this puzzle one piece at a time.” Marie read the inscriptions beginning again. “*To make one, you must take one...With an element and an acid you will make one.*”

“AN ELEMENT”

“Yes, I need to pick out one of these elements from the table. It needs to get mixed with the acid – I think.”

“YES”

“*The element is related to your past, future and present.*” Marie read. “This is the Fibonacci part. I think that the element will have a Fibonacci Number for an Atomic Number.”

“0, 1, 1, 2, 3, 5, 8, 13, 21, 34,…” Atlas started to name the numbers.

“OK, then it says: *After the first choice your choosing is spent.*”

“WE GET ONE SHOT AT THIS”

“I think that’s what it means.” Marie read on, “*The element’s positive is prime in value. The element is metallic and non-flammable too*” She grinned at the ‘prime in value.’

“METALLIC TOO”

“Yes! I suspected that it was metallic because metals tend to be reactive in acids. I think that narrows it down

just a little. Most of the elements are metallic. We will just have to check our answers to see if they are flammable.”

“RADIOACTIVE” Atlas urged Marie to finish reading.

“Radioactive it is not. Don’t touch the ones that are hot.”

Marie looked at some of the elements and saw that a few seemed to glow. They were radioactive. “This one is obvious. We don’t want any radioactive material. Any of those elements would be hot.” She thought of how radiation given off of radioactive elements could actually burn people – they really were ‘hot.’

“AND PATIENCE”

“Yes, the rest is on being patient. I will do my best. I think there is definitely an effect from the vapor that is making me agitated.” Marie waved the vapor around with her hands.

“YES. THE VAPOR IS NOT GOOD”

“OK, so that first part is about taking one to make one. What is ‘one’ supposed to be?” Marie looked at the symbols.

“ONE”

“Like the number?”

“MAYBE”

Marie thought about it and became convinced that ‘one’ was really the number one. “One in a previous test

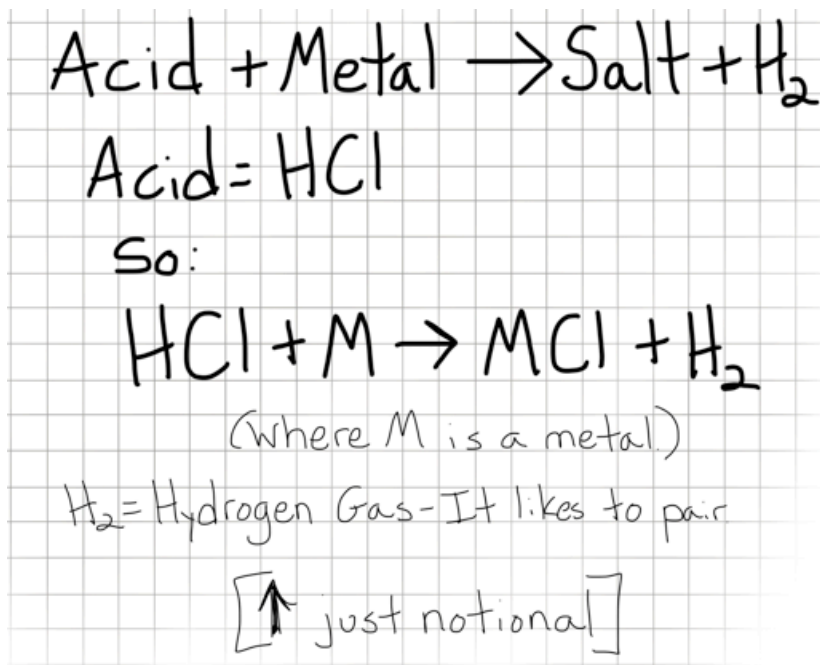
was Hydrogen - One proton in the nucleus, so an atomic number of one, and balanced with a negative electron by itself.”

“HYDROGEN – YES”

“OK, so take an ‘element’ to make ‘one’ or, in other words, let’s take an element to make Hydrogen.” Marie realized the simplicity of the puzzle. “Duh! Metals mixed with acid will create Hydrogen gas. It’s a double replacement reaction.”

“YES”

Marie took out her notebook and drew a notional reaction:



“OK, so we need to find a metal that will react with HCL.” Marie thought through the puzzle aloud. “So why don’t we write down the elements that have the atomic number of a Fibonacci number?”

Marie felt a surge of joy in her heart. She had never foreseen that memorizing all of the elements would be useful in such a way. It had been such an accomplishment to memorize, and now it was being put to use. Images of her sketches and drawings of the table and all of the elements flowed through her mind. Her mission now depended on her knowledge of the elements.

“LET’S DO THIS”

“Yes!” Marie said with enthusiasm as she took out her notebook and started to recall all of the elements. She created a table to visualize her thought process.

“ONE” Atlas started to name the Fibonacci Numbers for Marie.

“One is Hydrogen (H). Not a metal.”

“TWO”

“Helium (He). Not a metal.”

“THREE”

“Lithium (Li). It’s a metal. It’s pretty flammable.”

“FIVE”

“Boron (B). It’s not a metal.”

“EIGHT”

“Oxygen (O). It’s not a metal.”

“THIRTEEN”

“Aluminum (Al). It’s a metal. ”

“TWENTY-ONE”

“Scandium (Sc). It’s a metal.”

“THIRTY-FOUR”

“Selenium (Se). It’s not a metal.”

“FIFTY-FIVE”

“Cesium (Cs). It’s a metal.”

“EIGHTY-NINE”

“Actinium (Ac). It’s a metal. It’s very hot.”

“ONE HUNDRED AND FORTY-FOUR”

“Ha! Atlas that’s funny.” Marie laughed at Atlas’s joke.
“There aren’t one hundred and forty-four numbers in The Periodic Table.”

“HA” Atlas and Marie surged with a moment of joy.

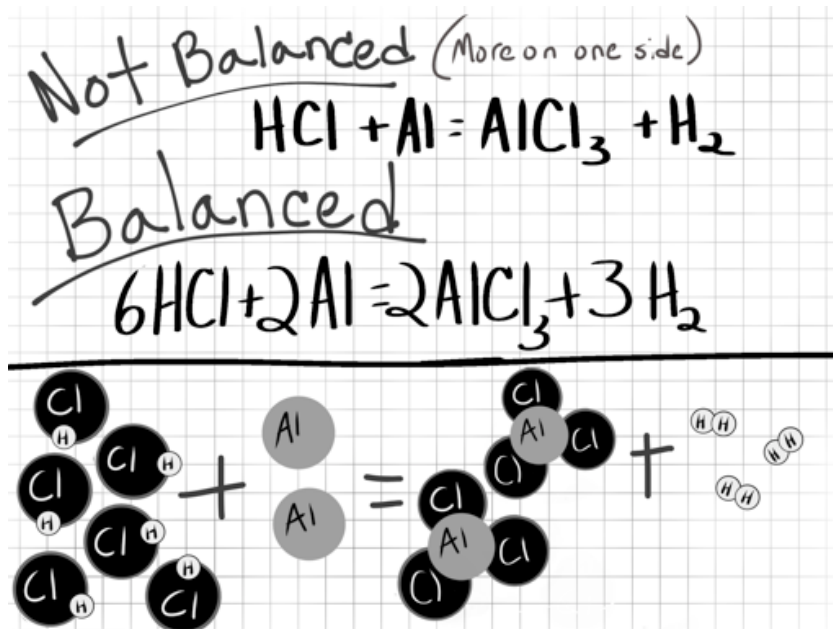
“So, let’s give them an ‘X’ if they aren’t prime, non-metallic, flammable, or radioactive. I’ll use a check to show that it meets the requirement. If we don’t know something, then we will use a question mark.”

#	Prime	Metal	Non Flammable	Not Hot
1 → H	✓	✓	✓	✓
2 → He	✓	✓	✓	✓
3 → Li	✓	✓	✓	✓
5 → B	✓	✓	✓	✓
8 → O	✓	✓	✓	✓
13 → Al	✓	✓	✓	✓
21 → Sc	✓	✓	✓	✓
34 → Se	✓	✓	✓	✓
55 → Cs	✓	✓	✓	✓
89 → Ac	✓	✓	?	✓

Aluminum was the only metal that was prime, not flammable, and not radioactive. Marie picked up the Aluminum from the table and brought it over to the edge of the pool. Marie looked down into the acid at the threshold to the glowing liquid.

Marie received a reassuring feeling from Atlas that she should toss the Aluminum piece into the pool. She threw the chunk of Aluminum into the pool of acid. As the piece

started to react, Marie visualized the chemical equation in her mind and balanced it as the Aluminum sank in the pool. Balancing chemical equations is part of a section of chemistry called stoichiometry (in Greek it translates to measure of elements). Balancing equations was always a fun activity for Marie.



Bubbles formed and the Aluminum reacted with the acid. When the Hydrogen gas (H_2) was released through the bubbles, it touched the platform. The platform was levitated back up from where it came and the remaining liquid in the pool started to drain.

“The level of the pool is going down.” Marie saw a

gradual decrease in the volume of the pool.

Lodestar pointed to the bottom of the pool. Marie waited next to the edge of the acid for a long time as it steadily receded. She could see a drain at the bottom that was sucking the acid down. The vapors diminished and so did her tendency towards irritation. She waited peacefully and patiently for the very last drop of liquid to leave. She waited until a metallic dripping echo ceased in the drain.

Before her stood a large, glowing, empty bowl. The symbols at the base were radiant. Atlas urged Marie down into the basin. Marie felt a surge of relief. She and Atlas, the Cosmos, had just rid themselves of a large quantity of acid.

And just like that, Marie felt overcome with gratitude. She was grateful to have her friend again on an adventure. She embraced her moment of pure joy. Atlas felt the same.

“WE ARE COSMOS”

“Yes we are.” Marie smiled.

Marie turned her attention back to the bottom of the bowl. She saw that the symbols were repetitions of one word. It was written big and small in ways that looked very fractal-like. The word was “Gentle.” Lodestar pointed to the center of the symbols.

“PRESS THEM”

Marie leaned down and gently pressed them with her hands. “Here we go,” she thought, as the bowl cracked

down the middle and opened up at the base.

Marie felt like a grain of sand being released from cupped hands. She was falling down into pure light. She did not shrink or turn into beams of particles. She just fell down, down, down until she landed on a cloud of white. There she stood on the clouds in a new setting, ready for the next test.



✧ GENTLENESS ✧

Marie was amazed at the clouds under her feet. Somehow she was able to walk on them without sinking. She walked up and down rolling hills of fluffy cotton-like gases. The shapes reminded her of cumulus clouds on Earth. As she came over the last rolling cloud hill, the cloudscape changed into a flat plane with a mountain-like gem's peak piercing through the center off in the distance. The plane was a perfectly beautiful lenticular cloud that formed as if the gem was creating its own weather.



Lodestar pointed directly at the gem protruding above the planar surface of the lenticular cloud. Marie followed Lodestar's compass. The arrow seemed to point in a direction that proceeded from Marie's heart. She felt

direction at an intuitional level. She walked with a longing for the gem in front of her.

The gem was like a fantastical fortress made out of a ruby. Its red light reflected on the lenticular plane and seemed to warm Marie from within. She was speechless. No words or thoughts were needed for her long journey to the peak. She was content with Atlas's company and the gentle crimson plane that lead her to the next test. Marie absorbed every second of this peaceful feeling into her being.

Marie approached the base of the crimson gem and looked up with admiration and amazement for some time before she could speak. It was beautiful. It had been hours (if not days) of silence and rhythmic walking and she had become nearly entranced.

“SYMBOLS – OVER THERE”

Marie saw that Lodestar was pointing to a marble-like stone a few steps away. She walked over to it. “We are here. We have made it to the next test.” Marie knelt down and read the symbols:

*Closer to a cure you get,
But not there just yet.
Three steps for this test,
Numbers, elements, and build a nest.*

Pass or fall into eternal slumber.

First comes the test of number

Prove that one can equal three

*Break one mathematically nothing rule to
let this be*

Next come the Elements:

Find the state that can compress and grow

Make that state and let it blow

And build a nest:

From the clouds build a nest

Use gentle words and deeds to be your best

From this wings will fly

From here to another sky.

“So three steps...” Marie re-read the words again to think them over. “Since gentleness is the theme here I will try to be gentle in every way.”

Marie stood up and looked at the empty square to write

the proof that one can equal three. She was trying to think about making one equal to three. This was against the very nature of mathematics. Numbers are numbers because they are defined as such. She wondered what a ‘mathematically nothing’ rule was.

“NOTHING”

“I don’t know what a ‘mathematically nothing’ rule is.” Marie focused on the word ‘nothing’ after Atlas had said it.

“NOTHING”

“Nothing, you keep thinking nothing. What is nothing? In our last adventure ‘nothing’ was zero.”

“ZERO”

“Zero? Is there a rule that we can break with zero?”

“MAYBE”

“That’s it!” Marie focused on zero. “It’s the most obvious rule to break.”

Atlas articulated Marie’s thought, “THOU SHALT NOT DIVIDE BY ZERO.”

Marie thought of the posters mass produced for teachers to hang on their wall saying ‘Thou shalt not divide by zero.’ She laughed to herself and thought of her own homeschool classroom with Fibonacci sketches, a poster of Albert Einstein, calculus formulas, and comic strips on various topics. She had never put the rule for zero up, and now she wondered why.

“ZERO”

“Yes, back on track.” Marie focused her thoughts back onto breaking the rule. “Well, if we break that rule and decide that dividing by zero is OK, then math just doesn’t work so well. You can prove that one can equal anything. Numbers can lose their meaning.”

“YES”

Marie started to write the proof that one could equal three in her notebook to make sure she had it right. It felt wrong breaking a basic rule. She felt like the math police might sweep out of the sky and come and put her in jail at any moment.

“MATH POLICE?”

“It’s a thought.” Marie smiled. “It is a very important rule.”

Marie checked the work in her notebook to make sure that it made sense. She felt like this page would have to get removed and burned when she got back home.

“BURNED?”

“Maybe it’s a little extreme, but this feels so wrong.”

“READY?”

Marie looked down at her notebook again:

If you can divide by zero:

$$\boxed{\frac{0}{0} = 1}$$

$$3 = 3$$

$$3 = 1 + 1 + 1$$

$$3 = \frac{0}{0} + \frac{0}{0} + \frac{0}{0}$$

$$3 = \frac{0 + 0 + 0}{0}$$

$$3 = \frac{3 \times 0}{0}$$

$$3 = \frac{0}{0}$$

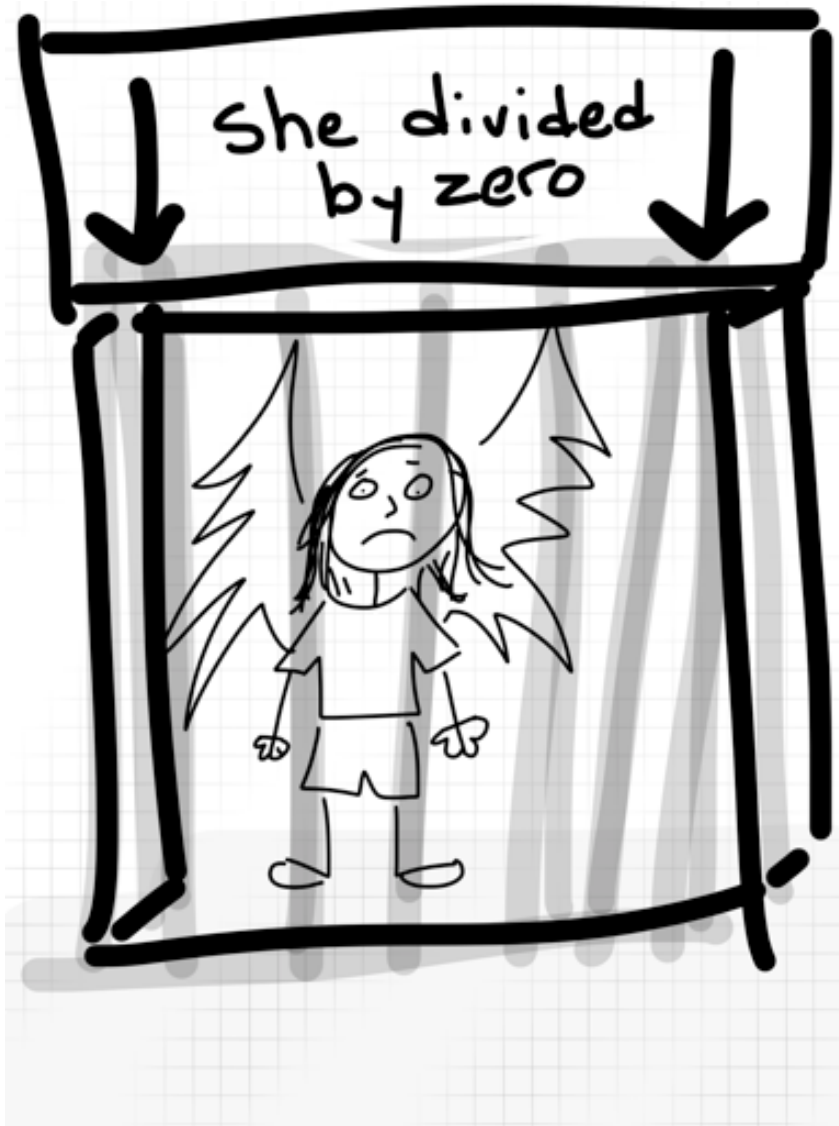
$$3 = 1$$

This is
how you
add fractions
 $\frac{1}{2} + \frac{1}{2} + \frac{1}{2} = \frac{3}{2}$

“When I break this rule, then numbers fall apart. Three can equal one!”

“YES”

“OK, I’m ready.” She felt like she should look over her shoulder for the math police again.



Marie knelt down to write her proof into the blank square. She noticed that when she touched the square with her finger that it was so fragile it felt like a thin pane of glass. She pulled her finger back and saw that she had left a

crack where she had barely touched it.

“It’s not going to work. It’s too fragile. My finger will break the place where I need to write the proof.”

“ANOTHER WAY?”

“Huh?”

“SOMETHING SOFTER? MORE GENTLE?”

“Um, like what?”

Marie sat down gently on the cloud. It felt like if she made any hard movements, she would fall straight through the clouds. She looked at the flat cloud and noticed how similar the surface was to liquid. It reminded her of the pool she had just left. Marie started to rewind the sequence of the last test in her mind. She and Atlas came to the same solution together.

“FEATHER”

“A feather! A feather can write on a pane of thin glass.” She joyfully spread her wings and gently shook them to see if any feathers were loose. Marie had just lost a small pointed feather from her right wing. She jumped and grabbed it before it flew away, careful to land softly with her feet on the clouds.

She took the feather and gently traced the math proof onto the fragile square that was prompting her after its last touch was so harsh. It mended itself and began to glow with a bluish hue. It mixed with the scarlet light to become

a deep purple. The square turned into a table that stood as high as Marie's waist. A beaker-like container formed on the table. It had an interesting-looking liquid within it.

“MORE SYMBOLS”

“One for fire and one for ice.” Marie looked closely at the symbols, “I think we have to choose which one is right.” She re-read the inscription for the second step of the test carefully again.

Next come the elements:

Find the state that can compress and grow

Make that state and let it blow

Marie studied the beaker of liquid to see if she could tell what it was. The harder she tried to see what was within the beaker, the less she was able to see altogether. She felt like the beaker was blocking her from studying the solution within. Frustration started to grow within her. She couldn't see anything and became frustrated at the beaker.

“YOU ARE SINKING”

Marie was starting to sink into the clouds.

“BREATHE AND BE PEACEFUL”

Marie continued to sink.

“YOU KNOW THIS TEST. PEACE. GENTLE!”

The more frustration Marie felt, the more she sank into the clouds. She wasn't listening to Atlas. Her frustration with the beaker was clouding her thoughts.

“BE GENTLE”

Marie heard Atlas's words as she realized that she was neck deep within the cloud.

“WITH YOURSELF, BE GENTLE”

With great concentration, Marie started to let go of her frustration with the beaker. Her sinking started to slow down.

“PLEASE! PEACE!” Atlas almost felt panicked.

Marie could only see pink clouds around her face and she felt a pull downward. She could hear Atlas more clearly now that she was less frustrated.

“MARIE! GENTLE.” Atlas sensed that Marie was still in danger.

Marie stopped sinking as she listened to Atlas's plea. She began to breath deeply and stopped fixating on her inability to look within the beaker. Marie started to rise out of the clouds as she found her peace. Her wings seemed to lightly grab the soft tufts of gas as they emerged from the clouds she had sunk into. She did know the test. She found peace from within to practice gentleness.

“Peace. Gentle thoughts. I am calm.” Marie looked

down at her feet on a steady cloud surface again. “Joy is a choice. It’s not much of a choice when you’re not struggling. I’m making a choice. There is so much to be peaceful about. I don’t need to look into the beaker if it won’t let me.”

“YES”

“We can do this.” Marie read the symbols, “*Find the state that can compress and grow.*”

“COMPRESS AND GROW” Atlas repeated.

“A state that can compress and grow? That is related to temperature, pressure, and volume! And those laws are known as...” Marie paused for a minute and wondered if it was really as easy as she thought it was.

“YES?”

“I think it’s a matter of state, I mean a state of matter. Pun intended.” Marie laughed. “States of matter – solid, liquid and gas!”

“LIQUID”

Marie looked at the beaker and saw that the only information it was giving her was that it was clearly a liquid. Marie gently tapped the container to show that it rippled with small waves.

“LIQUID”

“Liquid, yes...the beaker has a liquid. Gas, liquid and solid are fundamental states of matter. There is plasma too,

but I don't think that we are going to make plasma (superheated gas that is in the stars)."

"COMPRESS AND GROW"

"It's gas! Gas is the state that compresses and grows (or expands) the most. All states can compress or expand, but gas really does it. There are laws for gas that are associated with pressure, volume, and temperature. If you change one, then it will change another while holding the third one constant." Marie was recalling her books on chemistry, "Temperature is proportional to volume when pressure is constant. This means that if there is a higher temperature, then there is more volume. Pressure is inversely proportional to volume when temperature is constant. That means that if there is more volume, then there is less pressure (opposites). And pressure is..."

"RUNNING OUT OF TIME" Atlas alerted Marie. The beaker's liquid was slowly draining from the bottom.

"Ok, so we have to make a gas! How? There are only two choices: fire or ice." Marie quickly answered her own question, "Fire!"

"FIRE"

"Fire! Heat expands a liquid into a gas! It needs to reach its boiling point so it evaporates into gas." Marie pressed the fire button. The liquid started to steam at the surface and bubbles began forming on the bottom until a rolling boil was reached.

“LET IT BLOW”

“It said to ‘let it blow,’ so shall I?” Marie took a deep breath and exhaled towards the boiling liquid to blow it away. The gem beside her glowed brighter with her breath. She did it again and it resulted in the same response. The gem radiated with such brightness that Marie felt its glow throughout herself. With the last drop of liquid evaporated, the gem started to slowly sink beneath the lenticular clouds. Marie watched it sink all the way down until there was only a pink glow from below clouds that she stood on. The marble still stood under her feet.

From the clouds build a nest

Use gentle words and deeds to be your best

“We must build a nest.” Marie saw another slab of marble-like stone that had just risen to the surface at their feet. “Gentle words and deeds, how should we start?”

“GENTLE DEEDS” Atlas rendered thoughts of gentle deeds to Marie.

Marie stooped down and scooped up a handful of cloud. It felt like mud, yet it didn’t stick to her. It reminded her of how swallows built thin nests with mud pellets that they brought with their beaks to hang from barns, cliffs, or overhangs. She brought her scoop of cloud over to the

marble slab and thought of how gently she had held a bird that had fallen from a nest when she was very young. She placed her thought into the cloud in her hand and carefully placed it onto the stone.

Marie realized that the first pellet had been placed and now it was up to her to continue placing them all until a nest was built. She scooped a handful of cloud and placed a thought of how gently she would hold her grandmother's hands as they went for walks. She laid her pellet next to the first one.

Marie laid gentle thoughts and deeds into her tender nest. Each cloud pellet was infused with gentleness:

Gentle footsteps though a garden
Gentle words to a friend that is sorrowful
Gentle touch to plant a seed
Gentle arms to hold a baby
Gentle spoon to the sick
Gentle smiles to those you pass
Gentle shelter brought to those who need
Gentle touch to a pet
Gentle words to consult with others
Gentle with yourself inside and out

Gentle hands to comfort the afraid
Gentle hands to help those that have fallen
Gentle with thoughts towards others
Gentle hope for those that have none
Gentle kindness to those in need
Gentle with belongings
Gentle existence to bring peace to all



Marie worked for hours laying one cloud pellet after another, until she had reached over a thousand pellets and

her nest was complete. Every act of gentleness that she had ever witnessed was there. Every gentle thought, every gentle deed, every gentle word that she could come up with was placed into her nest.

Marie was now utterly exhausted from her task. She climbed into her nest and soothingly rested in the cradle of cloud. Her eyes felt heavy with the thick cloud caressing her tired body. She soon fell into a deep slumber. The nest lifted off the stone and started to float away as she slept. Her dreams were of clouds and gentleness.

*From this wings will fly
From here to another sky.*



✧ GENEROSITY ✧

The nest floated to another place and another time. Marie slept through its quiet flight for a long time until her energy was restored. When she awoke, she saw that she was floating through a sea of immense energy. Somehow dreaming and reality seemed even closer together. Small objects of light seemed to whiz by her at speeds that were so fast that a normal human eye could never see them. Large spherical bodies stood out in the distance. It was like a vivid dream.

Lodestar pointed to one of the larger spherical bodies off in the distance and the nest seemed to change its route with the will of the compass arrow. Marie loved the

splendor around her. It felt like she was in space and yet it didn't look like the space, galaxies or stars that she had seen before.

The nest finally arrived at the surface of a large, spherical body. Marie took a minute to run her hands over the nest that she had built in admiration before she hopped off. When she was no longer in contact with it, the nest floated away and left her on the spherical body.

Marie looked down, and yet again there were symbols at her feet. She knew it was time for her next challenge. She yawned and stretched her arms and wings out before she began to read them. Atlas seemed to yawn and stretch along with her. They had both risen from a deep sleep.

Marie stood next to the symbols and read within her mind:

*A new sky you are in
You have diminished in size yet again
You are only reflections in this sphere
All things have been altered here
Altered to help you comprehend this space
Like a light to a mirror its reality is in
another place*

Three steps in this test

Do them without rest:

Step 1

*Cosmos must identify the infinity of existence. Is
it real or is it natural?*

Is it generous?

Step 2

*Cosmos must define this space with a single
symbol.*

Is it generous?

Step 3

Void of everything, find generosity

STEP 1: INFINITY'S NATURE

There was a clear path to the first step that was highlighted in yellow. Marie followed the yellow path on the sphere. As she walked, she started to dwell on the

word-symbols of the first step. The symbols were asking if the infinity of existence was real or natural. Marie started to meditate on the very definition of real and natural. She started to talk to Atlas on the quiet, empty path that seemed to go on forever.

“A Natural number is one that you can count with ease. The Natural Numbers go like this ... 1, 2, 3, 4, 5, 6, 7, and so on.” Marie thought, as she remembered how the set of Natural Numbers was written in her Numerical Analysis textbook. A set of numbers would be shown with curly brackets around it and then have the numbers that defined it within.

$$N = \{1, 2, 3, \dots\}$$

“The size of the set of Natural Numbers is infinite. It goes on forever.”

“INFINITE”

“Infinite, yes...” Marie walked for some more time and thought about subsets. “A subset is a part of the whole set. So a subset of Natural Numbers are the numbers 1 through 5. I will call this subset ‘n’.”

$$n = \{1, 2, 3, 4, 5\}$$

She stopped on the path to think with more focus. “The cardinality of my subset ‘n’ is 5.” Marie loved the word cardinality. It was such a lovely five-syllable word to describe the size of a set. “The subset would not be

infinite.”

$$|n| = 5$$

“RIGHT”

Marie started to walk again. She was happy with the basic definition of Natural Numbers and now was starting to think about Real Numbers. She remembered that Real Numbers included almost every number she could think of. They included the Natural Numbers, Negative Numbers, Irrational Numbers (like Pi), and so on.

“REAL NUMBERS, YES” Atlas followed Marie’s thoughts.

“So let’s say, I wanted an example of how I could count with Real Numbers from 1 to 5 just like with my set n:

1
1.1
1.11
1.111
1.1111
1.11111
1.111111
...

...And it would never end. I wouldn't even get to 1.2." She remembered how Real Numbers were everything except Imaginary Numbers and "infinity."

"Natural Numbers are considered to be countable infinity and Real Numbers are considered to be uncountable infinity. You can't even think about how to count them."

So the set of Real Numbers from the numbers 1 to 5 would have a cardinality (or size) of infinity. Real Numbers surrounded Marie every day, but when she really thought about how complex and immense the set of Real Numbers was, she was struck with awe and admiration.

Marie thought that contemplating the set of Real Numbers was similar to how she felt when she flew for the first time, or when she started to think about the universe, then stars, then solar systems, then planets, then life, then the atoms that made up all matter.

She was humbled by her tininess and the might of everything and all of the energy in her life. She felt that the abundance of everything around her was generous. It was an abundance that dwelled in every star, every planet, every molecule, and every atom. Generosity of wonder and delight was beyond her comprehension and she knew it.

She felt so small as she walked down her yellow path and started to realize that she was able to answer the questions asked by the symbols of her test. She realized that her life was in the realm of an infinite reality. It was so

infinite that it was uncountable infinity. The words repeated in her mind:

...identify the infinity of existence. Is it real or is it natural?

Is it generous?

“The infinity of existence is real! It’s real and it is uncountable infinity in size! It’s abundant and generous. It has cradled my life and growth and being. It has done this for everything and everyone. This existence is generous!”

When she said these words with enthusiasm, humility and wonder, the path at her feet faded. She realized that the ground was transparent and within it were infinite amounts of parts and energy. When she looked up she saw other balls of energy whizzing by. She had the feeling that she was in a vivid dream again.

When she answered the first question, her path turned green. It was time for the second step of the test.

STEP 2: DEFINING SPACE

Marie walked down the green path and focused on the words for the next step. She repeated them in her head as she walked, taking in her surroundings.

...define this space with a single symbol.

Is it generous?

Marie started to fly down the path and repeated the words in her mind. She stayed above the green path, but was high up like an airplane looking down at a single green streak of a road on a sphere. She noticed energy shooting by her to the left and to the right. It wasn't moving in a pattern and seemed to be all over the space that she was in.

“DEFINE THIS SPACE”

“What is this space?” She looked at the sphere below her and the energy moving around in every direction. There were other spheres far off in the far distance that she could see.

“WHERE ARE WE?”

“Define this space’ – Maybe I can see the matter that this is made of!”

“ZOOM?”

“Yes, let me try.” Marie flew back down to the path and tried to zoom into the material at her feet. There were pieces and parts within the sphere, but they weren't atoms. She was perplexed by her situation. “Everything is made of matter! What is this stuff?”

“WHERE ARE WE?”

“I don’t know yet. There is all this energy I have never seen before, and I feel like I am in a dream – and that feeling keeps getting stronger.”

“WHAT IS THE ENERGY?”

Marie stopped on the path and started to contemplate the energy all around her. She was amazed at the energy below her feet and the energy that seemed to move above her head at tremendous speeds. She was stumped and could not think of what this place was. It was like no other that she had ever seen.

“LODESTAR”

“What? Lodestar?” Marie looked at the compass on her arm. She watched Lodestar and realized that the arrow on the compass seemed to jump around and dance every time a ball of energy whizzed by. Lodestar was pointing to the energy.”

“LODESTAR IS GUIDING”

“Yes, just like a compass pointing north to a magnetic charge. What does it mean?”

“OBSERVE, HYPOTHEITIZE,...”

“Yes! Absolutely!” Marie laid down on surface of the sphere to study the energy that kept whizzing by. “I need to observe this energy’s behavior.”

“YES”

As Marie rested on her back and gazed at the humming

balls of energy, she realized that it was the same way that she gazed at meteor showers with her family back home. She zoomed in and noticed that they too were made up of smaller pieces that weren't atoms.

"It's almost like these balls of energy are attracted to the larger spheres and are getting passed from one sphere to another." She thought.

"YES, ATTRACTION"

"I feel like I should know where I am, but I am so lost. What is this space? Energy is attracted to these sphere-like bodies and passed from one to the next." Marie thought about being smaller or 'diminished in size.' "Am I in a bloodstream? With cells?"

"NO"

"Yeah, that doesn't make sense. Cells are made of atoms. We are smaller, but by how much?" Marie repeated the words from the start of the test:

A new sky you are in

You have diminished in size yet again

"Cells have so many more parts and I don't see those parts of a cell in these spheres." Marie looked harder at the sphere below her. She noticed that there were thirteen balls of energy within the sphere.

"THIRTEEN WITHIN"

“Thirteen, thirteen...” She jumped up with excitement and realized that thirteen had already come up on their adventure. “Thirteen is a Fibonacci number! Thirteen is the atomic number of Aluminum! Aluminum has thirteen protons in its nucleus...” She started to vibrate with excitement. “I’m...on...a...nucleus!”

As she started to comprehend where she was, she started to shake with complete admiration and wonderment. Marie realized that her size had truly diminished to an infinitesimally small status. She was on an atom. “Wait. I’m not really on an atom.” She remembered the other parts of the test:

*You are only reflections in this sphere
All things have been altered here
Altered to help you comprehend this space
Like a light to a mirror its reality is in another place*

“It’s like virtual reality or like we are projected into this reality so we can understand it. We are here, and yet we aren’t. Just like reading - I am a detective in some books, and an elf in others. It’s like a computer simulation or something.”

“PROJECTING”

“Yes, we are projecting here. We are in this virtual space standing on the nucleus of an atom – an Aluminum

atom!” Marie looked around again. “And electrons are whizzing by from one atom to another!”

Marie was amazed that she was able to see the nature of a chunk of Aluminum in such a unique and marvelous way. The electrons didn’t stick with one atom but were passed around. “It’s a sea of electrons! Metals share their electrons and that’s why they conduct electricity so well. The electrons with their negative charge, freely move within this sea...”

“IS IT GENEROUS?”

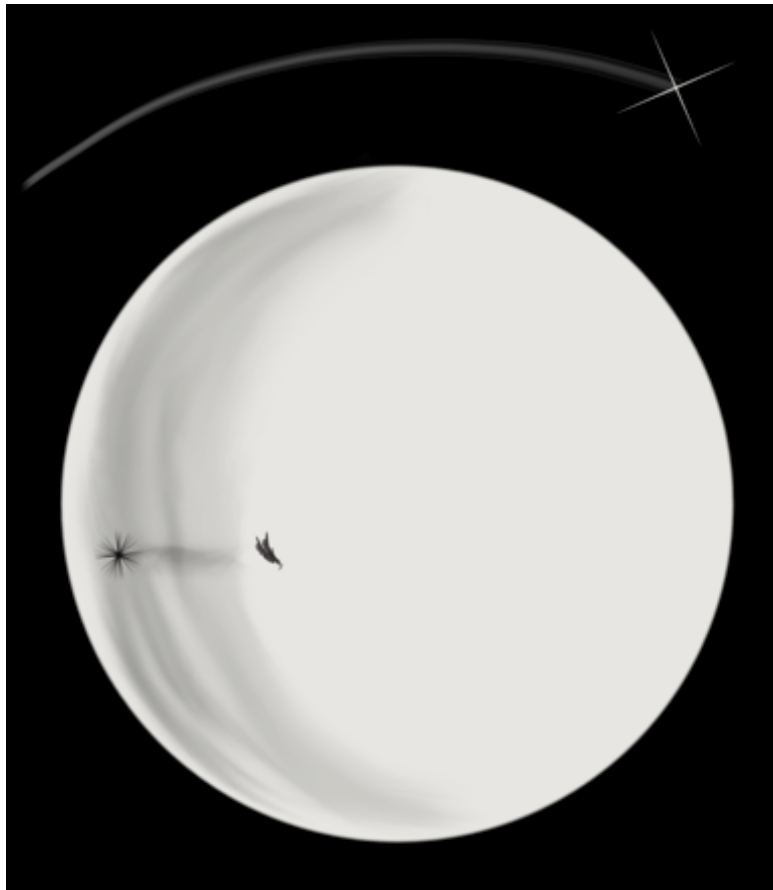
“Being able to exist and even peek into this realm is generous. I will never be the same. The energy that is shared through this space is given freely. It is like a joyful smile that spreads through a town. It is like the energy of love that moves through everything. It is like the energy of life that is in the smallest and grandest of matter. The energy that makes the nerves fire for a heartbeat, the energy that makes the warmth from the sun, the energy that nourishes all life, - it is generous. Yes, yes, yes, this energy and this space are generous.”

“YES IT IS”

STEP 3: FINDING GENEROSITY

“Void of everything, find generosity”

Marie realized that the surface that she was on was starting to grow thin. It was as if the sphere that she was standing on was a glass ball that was cracking on its surface. Thin ice cracking would have given her a similar feeling. Marie couldn't do anything as the surface broke under her feet where she stood. She fell through the opening. As she fell, she tried to fly, but to her great consternation, found that she could not!



Marie fell through the center of the sphere, and then, suddenly, she was still. She looked around and saw that the space around her was transforming. Like a movie fading to the next scene, the space around her became a single room. One moment she was floating in the center of the sphere, and the next moment, she was standing in a grey chamber.

The room had a grey floor and a matching grey ceiling. There was a mural of grey people on the wall. Marie looked down at her hand and realized that she was grey as well. She had no wings, no shoes and only paper-like material for clothing.

Marie tried to talk through thought, but found that she had no voice. Atlas could not communicate with her, either. Marie could not hear or smell or feel touch. She could move and see – that was it.

“I have nothing right now.” Marie thought to herself. She felt nothing from Atlas. She stood still and started to feel like she was void of hope.

Marie looked into the faces of all the grey people in the mural. They were all hopeless. “It’s as if they can only see, and have lost their ability to move. They are so helpless and hopeless.”

Marie looked at the peoples’ sad expressions in the monotone light. She felt their hopelessness and also as if she had nothing to give. As her hope faded, so did her color and dimension – her hand started to flatten into paper. She looked at her hand and realized that slowly all of

her body was transforming into dull, grey paper. She was startled, for she was becoming another person for the mural.

“Focus, I need to focus. I don’t want to become part of that painting.” Marie started to focus on the words ‘find generosity.’ With a sudden awareness, she knew that she had to find a way to be generous.

The wall started to slowly pull Marie towards it as she became more paper-like. She rummaged through her mind for a generous idea when she felt like she had nothing to give.

“Smile!” Marie thought of a single, simple word that could bring hope. Even though Marie had felt hopeless, she didn’t feel like she couldn’t *give* hope. With a deep breath through her almost paper-like lungs, she spread a beautiful, generous and hopeful smile across her face. She smiled right at the people in the mural.

The mural people felt the warmth of the smile and hope grew within them. It warmed their grey selves and nourished their beings. The mural became colorful as, one-by-one, the people returned their smiles back to Marie.

The room became colorful, and the people walked away from the room through the painting into a beautiful countryside. Marie’s body became whole again and she regained her voice, telepathy with Atlas, her wings and the rest of her senses. She felt hope and peace.

“HOW GENEROUS”

Marie reflected on what had just happened between her and the people in the painting. “When you feel like you have nothing to give, when you feel hopeless and poor, you still have something. You can give a smile, a hug, a comforting word, or love. We have something even when it feels like we have nothing. We always have something to be generous with.”

“YES”

“Sometimes the happiest people are the ones that have only smiles to give. It can mean so much.”

Marie had found generosity. She started to stretch into streams of particles. She was on her way to her final test.



✧ THE FRACTAL OF TIME ✧

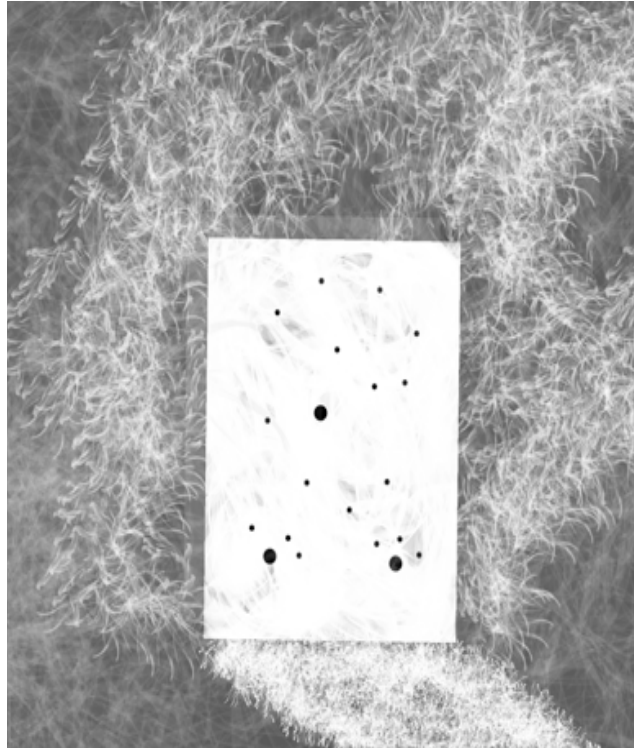
Marie arrived in another dream-like room. A monolith stood before her. It was made of a magma-like material. It swirled and moved like lava churning in a volcano, yet held onto its tall, rectangular box shape. Its black sunspot-type symbols within its surface seemed to pull her eyes towards them like black holes.

“PLASMA”

“I was just thinking that it looks like plasma - Superheated ionized gas that acts like no other state of matter. It tends to respond to electricity and magnets since it has positive and negative charges.”

“PORTAL”

“A portal? It looks like this monolith could be the surface of the sun. I feel like my eyes burn just looking at it and yet I can see every band of light coming out of it, just like the sun. When I zoom in, I can see that there is lots of Hydrogen.” Her enhanced vision allowed her to see the intense light without damaging her eyes.



“READ THE SYMBOLS”

Marie focused on the sunspot-like symbols and read the words for her next test:

*Unity will bring a cure
This last challenge to endure
Three steps to have oneness be
The ultimate power you will see.
Step through this blaze to start
From this state you will part.*

“I wonder what or who the cure is for?” Marie wondered.

“MAYBE WE WILL FIND OUT SOON”

“Step through this blaze to start?” Marie read the symbols.

“YES, STEP THROUGH”

“Our state will part? What does that mean?”

“WE WILL FIND OUT”

“Does our state really change? I keep feeling like I am in a dream. Am I just a projection here? It feels so real.”

“DOES IT MATTER?”

“It probably doesn’t matter.”

Marie walked through the plasma monolith and was transformed as she entered another space. She became a

plasma-like being made of swirling gas, yet fully conscious and still holding most of her previous form.

“We are like a gas and liquid at the same time.” Marie stared at her hand, as it seemed to be made of flame and lava.



“This is amazing!” Marie stared at her hand. She was communicating purely through thought because her voice would not carry in such a place.

Marie approached a black spot that was the size of a window within the plasma room. Within the spot, she saw another space. It was like looking at a computer screen with a starscape.

“THE STAR”

“Star? Yes, star from the beginning?”

“YES”

“Where?”

“LOOK WITHIN”

Marie peered into the window and saw that there was a sphere. It seemed mostly cold with a residual heat deep within. Around the sphere were three planets that looked a lot like earth. Instead of having liquid, they were iced. Stars and galaxies were off in the distance. This space was similar to the outer space that Marie knew from home.

“It’s like that star lost its heat. Those planets are frozen.” Marie looked at the details of the solar system.

“DEEP SLUMBER”

“A deep slumber! Life seems to have been frozen for these planets.”

“VERY COLD”

Marie reached her hand out to touch the black spot and see if it was indeed a window. Her hand touched a clear glass-like pane. The planet that she touched on the pane zoomed in like a computer screen and showed her the surface.

There were amazing life forms everywhere she looked. The entire world was an ocean and within the ice were thousand-tentacled creatures, elephant sized snails, eels that glowed in rainbows of light, and dazzling corals. All of the amazing life forms were lifelessly frozen.

Marie reached out and touched the window again. The screen zoomed into a second planet. This planet was nearly all forest with trees that would get up and walk around and had thousands of eyes and muscular branches. There were birds with civilized cities of houses among the walking trees. Everything was asleep in hibernation. No life was stirring on this planet.

Marie touched the window again and it brought the screen to a third planet. This planet was full of the tiniest life forms. It had fields and fields of grasses. On the grasses were entire civilizations of microscopic salamander-like creatures, also frozen. Some of them were frozen next to the activities that they were doing before the freeze. There were painters, architects, musicians, and more. The population was unfathomable. There were trillions and trillions of blades of grass in just one meadow, and on each blade there were billions of these civilized life forms.

Marie was amazed by the life and beauty in each of the worlds. Marie went to touch the window's pane again and found that the glass surface was gone and had become a portal to the solar system. Marie was sucked into the hole-shaped window like a feather from a car window.

Marie floated in space at the edge of the solar system. Lodestar's compass pointed to the lifeless star at the center of the three planets. Marie was still in her plasma-like form. Her wings used the energy of the stars around her to propel her towards the sleeping star. Flying in space was weightless and wondrous. She was amazed at how magnificently beautiful the solar system was.

Marie flew to the surface of the star and saw a cave that lead down into its core. She followed Lodestar's guidance and flew straight down into it. At the end of the cave there was a table with symbols.

Solve this puzzle:

*A fractal of time you've come across
It is recursive for old and new
One iteration's gain is another's loss
For some people there are many and for
others a few*

*Define an iteration and a substance
you will gain
Without it success you will not attain*

Marie looked around to see if there were any other hints to the puzzle. There was nothing except the table with the symbols and a prompt for a single symbol to be written for the answer.

“OK, so it's a fractal of time.” Marie began to pace and think. Marie's glowing body paced back and forth like a sun weighted pendulum.

“FRACTALS. RECURSIVE. ITERATIONS.”

“Yes. Fractals are recursive. They repeat something over and over in iterations. Each iteration may be different

from the last, yet they go infinitely on and remain similar to their previous iterations.” Marie was stumbling over her words. “It’s like a tree, or a fern, or a snail’s shell.”

“BUT WHAT IS A FRACTAL IN TIME?”

“Well, it would have to be something that repeats, yet is slightly different each time.” Marie thought about time and fractals methodically. “It says that it’s recursive for old and new.”

“OVER TIME”

“Yes! Over time! So let’s assume that it is more than one instant in time. Let’s assume that it goes on over time.”

“ONE ITERATION’S GAIN IS ANOTHER’S LOSS”

“I don’t know if I understand this part.” Marie shrugged her shoulders. “Maybe we should go on to the next part.”

For some people there are many and for others a few

She realized what this meant. People live for different periods of time. Some people live to be over a hundred years old, while others may die while they are young.

“LIFETIME”

“Time ... some people have more time than others.”

Marie fell quiet thinking about her own time. She was thinking about how each day was a blessing. No day repeats the same events, each day is similar, but is also unique.

“Each iteration loses what it has while the next one gains. Could it be a day?”

“A DAY!”

“Like the sun. It’s a new sun today with new gas to burn. Each old iteration becomes the past, while each new iteration is today. Time is like a fractal for us. We live in days. Each day starts with a sunrise and ends in a sunset. Each year is a set of days that goes in a circle. Every new day becomes the past as it continues in this fractal. That’s it! The answer is *a day!*”

“A DAY! YES”

Marie thought of how the picture must look if she was to try to draw the fractal of time. It became so complex she had to stop. She saw how it could be from past to present to future. She could redraw it with circles for each year, and bigger circles for each century and so on...



Marie went over to the table and printed the answer to the riddle – a day written in a single symbol. The table cracked perfectly down the center and fell to each side. The space where the table stood now had two vials of

liquid. She zoomed in and saw that the atoms had almost no energy and were behaving more like waves and all condensing together. This meant that the liquid was severely cold – like a Bose-Einstein Condensate (BEC) - a BEC is a state where individual atoms coalesce and then act more like waves.

“Oh my! Do you know what is in those vials?”

“YES”

“Of course you do, because you’re in my thoughts. It’s...it’s...it’s...liquid Hydrogen. It has to be colder than -420° F (-252° C). That is only twenty or so degrees above absolute zero.”

“VERY COLD”

“It’s not very far away from the lowest temperature possible! I think this is the substance that we must have for the next step.”

“YES IT IS”

Marie picked up the vials and the room started to vibrate. She felt the floor beginning to sink. It accelerated as it went down, going faster and faster. It was like an elevator going down that was speeding up. Marie was falling. She clung to the vials as she fell through a dark space. Her fall slowed down and then eased into a stop on cold ground. She landed on her feet and stood in the darkness.

“Atlas?”

“I AM HERE.”

“It’s dark.”

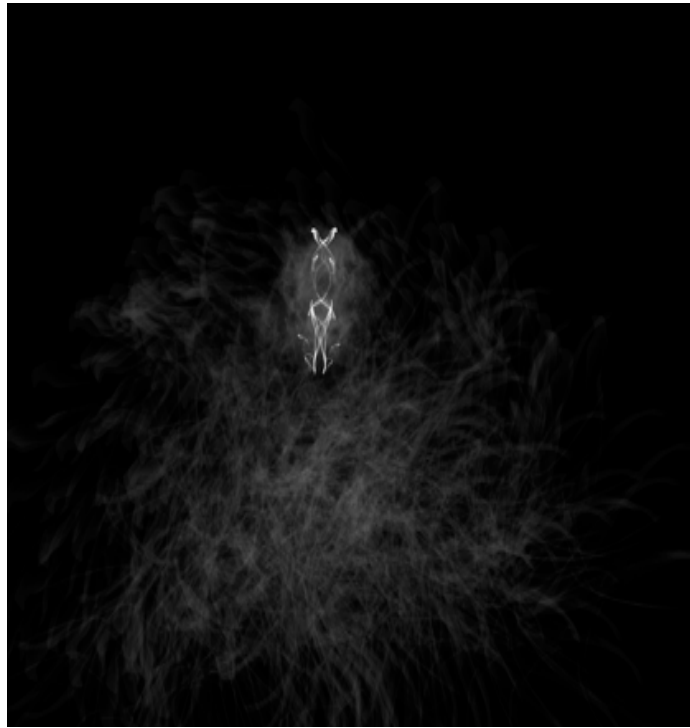
“YES.”

“What do we do now?”

“LODESTAR”

“Lodestar?” Marie looked down at the compass that had a faint glow. “Lodestar!”

Lodestar pointed Marie to the right, so she walked in the direction of the compass arrow. She and Cosmos walked in darkness for a long time before they saw a small light in the distance. It looked like a symmetrical flame burning in a white light. Lodestar pointed towards the light.





✻ UNITY ✻

Marie approached the flame with anticipation of where it would take her. As she got closer to the flame, her plasma body began to glow. Marie hadn't noticed how cold she had become before approaching the flame. She warmed herself while tightly holding the vials of liquid Hydrogen. The flame burned slowly, yet symmetrically, like it had a mirror in the middle. It had a rhythmic flame that was hypnotic.

“INTO THE FLAME”

“Yes, we need to go into the flame” Marie felt the pull of the flame on her plasma state, and she walked into it.

The mirror-like fire was a doorway into a spherical

room. The room was dark with the exception of a tube that circled the room in a ring shape. The ring shone with a glowing light.

As Marie moved towards the center of the room, another table grew out of the floor. It looked like a crystal table with etched symbols. Marie read:

*These last steps require a substance
from the last*

*If you pass you will make a new
substance appear*

*Your Hydrogen will flow through the
ring very fast*

A powerful energy will happen here

Before Marie read on she paused and confirmed her thoughts with Atlas. She was realizing that the slumber was indeed the sleeping star and the only cure would be to ignite it. The Hydrogen was going to help turn the star back on.

“FUSION”

“Nuclear fusion!” Marie said with excitement. She had

always been fascinated by the energy of stars (especially knowing that her wings were powered by stars from her last adventure.)

“FUSION OF HYDROGEN”

“Yes! Just like our sun – I think.” Marie smiled. “When Hydrogen atoms are fused to other Hydrogen atoms, they become Helium and release a huge amount of energy.”

“ONE PLUS ONE”

“One plus one equals two. Helium has an atomic number of two. Each Hydrogen has one proton, when they fuse together then there are two protons!”

“AND ENERGY IS RELEASED”

“Yes, a lot of energy is released with fusion. My guess is that the Hydrogen we have in the vials is just the amount to start the reaction – to ignite it. It will be like a snowball rolling down the hill and getting bigger. Our Hydrogen is just the start.

“RING”

“Yes! The ring around this room must be where the atoms will fuse. It must accelerate them until they collide at super high speeds.” Marie looked at the ring around the room as she communicated with Atlas.

“LIFE WILL THAW”

“Oh, all that life! Those wonderful planets will have warmth again.” Marie thought of the responsibility that was

now on her shoulders.

“WE CAN DO THIS – COSMOS”

“Cosmos, we are Cosmos. We have done so much together. We can do this.” She felt the weight of the solar system on her shoulders as she continued to read the symbols on the table:

First,

*Enter a function that has atoms input
and atoms output from fusion*

Next,

*Enter a function for the amount of
energy in the vials*

Last,

*Unlock the controls to start the
reaction*

“Functions are something I love.” She was getting excited. “The domain is what you input and the range is the function’s output.”

“YES, FUNCTIONS”

She thought of a simple function example in her notebook for how old a house is if it was built in 1999. The input or domain would be the current year.

function
age = f(year)
f(year) = year - 1999
so if year = 2016
f(2016) = 2016 - 1999
age = 17 yrs

Marie thought about the domain and range for the function in the first step. It was asking for a function that would have the domain (or input) be the number of atoms in the vials. The range (or output) of the function would be the number of helium atoms that would be produced.

“ONE PLUS ONE IS TWO.” Atlas confirmed that Marie’s thoughts were on the right track.

“So the function would be this:” She wrote in her notebook.

$a = \text{number of atoms}$

$$f(a) = \frac{1}{2} \times a$$

The number of Helium atoms would be half of the number of Hydrogen atoms. Marie thought that it was a rather simple function to be part of the test. She moved over to the table to input the function and saw that it was another computer.

“PROGRAM IT IN”

“Another computer?” Marie was grateful that the

function was simple and typed Python code into the computer.

```
h_atoms = float(input('Input the
number of Hydrogen atoms: '))
he_atoms = 0.5*h_atoms
print('The number of Helium atoms =
',str(he_atoms))
```

The computer screen confirmed that the code was correct and prompted Marie to move onto the next step.

“ENERGY OUT”

“It says ‘*Enter a function for the amount of energy in the vials*’” Marie read.

Marie’s mind focused on thoughts about energy. She pooled together all of her knowledge of math, physics, history and chemistry. She shuffled through all of the files in her mind to find every thought on energy she had ever had.

She found that one thought stood out for her in particular. It was an equation known by all of mankind. Albert Einstein had created it with his theories on relativity. “The amount of energy? That is more than chemistry – it’s physics.”

$$E = MC^2$$

E stands for the amount of energy. M stands for mass. C is a constant value, the value for the speed of light. They noted that C^2 is really just C times C (that's how exponents work.)

Now that Marie had the equation, she needed to write it as a function. What was the output? Energy. What did she have to input? The mass of Hydrogen in the vials. What was constant? C was always the same. Marie remembered what C (the speed of light) was from her physics books: $C = 299,792,458\text{m/s}$. She was amazed at how fast it was – almost 300 trillion meters per second.

“It's the universal speed limit.”

“MAYBE”

Marie thought about how man's understanding of physics changed everyday. “Maybe...”

Marie wrote her function for energy. The domain was mass, and the range was energy.

$$m = \text{mass of Hydrogen}$$

$$E = f(m) \leftarrow E \text{ is a function of mass}$$

$$f(m) = m \times c^2$$

$$f(m) = m \times 299792458^2$$

Marie noticed that the vials had symbols that appeared on them. The symbols said that the mass of each vial was two kilograms. That meant that she had four kilograms total of liquid Hydrogen. She had the value of mass to evaluate their function. Marie typed the Python code into the prompting screen at the table:

```
mass = float(input('Input the Mass in
kg: '))
c = 299792458
energy = mass * c**2
print('Energy = ',str(energy), '
Joules.')
```

The computer confirmed that she was correct. It showed that the energy in 4kg of mass was 359,502,071,494,727,040 Joules (3.595×10^{17} J).

“Wow! That is a lot of energy from these two vials! That’s more than a million tons of TNT!” It was overwhelming to think that much energy could come from less than 10 pounds of mass.

“I need to remember that it is the amount of energy in all of the Hydrogen. We aren’t going to turn all of the Hydrogen into energy, we are going to make Helium from Hydrogen. So, it won’t be that much energy when we ignite the star.”

“YES”

Marie pondered how much energy she was going to create when the Hydrogen fused. She thought out loud, “Well, when two Hydrogen atoms fuse they create a Helium atom that weighs a little less than other Helium atoms. When they fuse, a little bit of the Mass is turned into Energy. ”

“A LITTLE MASS CAN BE A LOT OF ENERGY”

“I think we are lighting a figurative match to a stick of dynamite. It is the spark to get the star ignited.”

The table changed colors from white to blue and then a message came to the surface. Their minds were still merged as they read together:

Cosmos is in unity

It is time to unlock the controls

You must create a diverse unity within each place

Paint it on this space.

There were five blank spaces and paints with two paintbrushes that appeared before Marie. She re-read the first line: “Cosmos in unity”

“US”

“We are Cosmos. Together we will do this.”

“DIVERSE UNITY”

We need to create five types of diverse unity for these canvases. “Diverse unity...where do we start?”

“WITH WHAT WE KNOW”

“OK, well, unity doesn’t mean that things are the same.” Marie thought of her family with all the different personalities at the table.

“WE ARE TOGETHER”

“Yes, that is true. We are very different, but have been unified in our actions and purpose.”

“PAINT”

Marie felt the chaos of unused color on the tip of the paintbrush and slowly brought it to the canvas. Her first

thoughts were on the teams of scientists that she saw working together over the years. They were from many countries and cultures. Even though they were very different they worked together in unison to perform science. Marie painted the lab within her mind and created a wonderful portrait of a team.

“YES, SCIENCE TEAM” Atlas fused to Marie’s thoughts.

When the first painting was complete, Marie began to think about music. She loved to play all kinds of instruments and even more so when she played with other musicians. She remembered going to a concert with her parents to listen to Beethoven’s 9th Symphony. It was amazing. All of the instruments played in unity, yet each instrument was uniquely different. Multiple variations on the theme swirled together to make a masterpiece.

“SYMPHONY!” Atlas surged with joy as music flowed through Marie’s mind.

Marie painted the symphony with splashes of motion and emotion throughout. Notes linked the musicians together as they followed the conductor’s cues.

“GARDEN?” Atlas commented on the next thought that entered Marie’s mind regarding togetherness.

“Gardens are more beautiful when they have multiple types of flowers and plants. Different heights, shapes, colors and textures complement each other. If there was

only one type of plant in a garden, then it wouldn't last as long and it wouldn't have the depth or beauty that a diverse garden would have."

"WONDERFUL"

Marie created a garden of depth, light, shadows, color, and texture. Colors surged through their thoughts and into their painting. Their garden would entice anyone to walk through it and admire its beauty. Marie felt herself wanting to walk among the flowers. "Oh, I do love this." Marie smiled at their artwork and thought of the next canvas.

"ART"

"Art is a great example. A rainbow wouldn't be interesting with one color, would it? The diverse colors, lines, and form give beauty, depth, and meaning."

Marie and Atlas, Cosmos, blended abstract shapes with gradient colors into a flowing masterpiece. It looked like a circular rainbow with light in the middle. Lines and flares were added with soft and rough textures, dark and light tones, and straight and curved objects.

Marie looked at the last empty canvas as she thought of home. It was a single word that she had deepened her understanding of in her last adventure – peace. She thought of all the different forms of peace that were within the flowers she had smelled trying to save the planet Maneo.

"PEACE"

"For peace to be on earth, there must be unity among

the diverse peoples. If they all focus on peace as their purpose, then they can create it.”

Together, they worked on their last painting with unified strokes and colors. It was a world with people holding the world together. They painted pillars of peace next to the people with words that read: equality, justice, love, compassion, truth, generosity, selflessness, kindness, and tolerance.

Marie thought of home and how she longed for that kind of peace. She was determined to be part of creating peace when she got back to her home. With the last paint stroke, the pictures levitated and floated up and out of sight. The controls became unlocked with the completion of the paintings. Two holes appeared next to the controls that were the same diameter as the vials. Marie placed a vial into each hole and locked it in with a latch.

The ring that encircled the room started to glow and vibrate. The entire room started to change around her. All she could see was a ring spinning around her and heard an immense noise as it accelerated the Hydrogen within. She saw a sunspot again below their feet and instinctively knew that it was her exit.

“We probably don’t want to be here when the atoms smash together.” She pointed to the black circle.

“PROBABLY NOT”

Marie went through the portal and arrived at a safe

distance from the sleeping star. She floated in space and watched the star being awakened from its deep sleep. It was a sight of splendor. Instead of a gigantic blast, the star slowly warmed back up while emanating swirls of color. She watched in awe as the planets defrosted and came back to life again.



✧ THROUGH THE WORLDS ✧

“Now what?” Marie asked as she looked at her glowing plasma hand.

“YOU MUST RETURN TO YOUR STATE”

“State?”

“INTO THE BUBBLE”

“What? I don’t understand?”

“OUT OF PROJECTION. LOOK AT LODESTAR.”

Marie looked down at Lodestar’s compass and saw that a small bubble was forming on the surface of the compass. It was growing slowly and began to encompass her.

“Bubble!” Marie exclaimed, as she felt her entire body

being sucked into the bubble. Marie closed her eyes. She felt transported again, but in a different way. It felt like she was being shaken from a deep slumber.

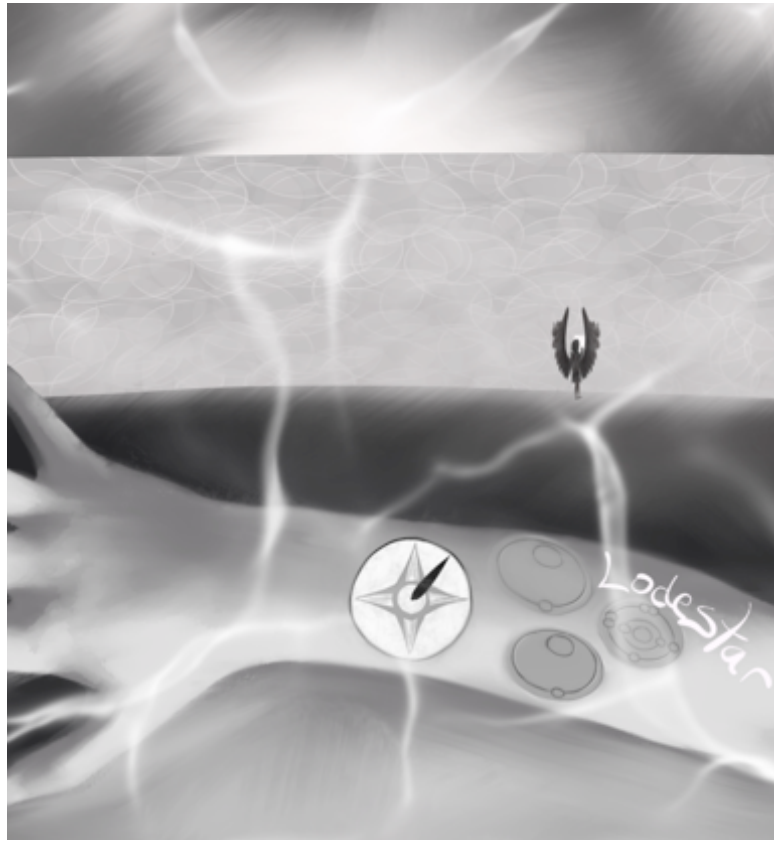
“LOOK”

Marie opened her eyes and saw Lodestar’s arrow pointing off in the distance. She was underwater again. It felt like she was back to where she had started the adventure.

“Déjà vu” Marie thought to herself. “I’ve been here before.”

“LOOK”

“Oh my!” Marie looked up from the compass and was stunned at what she saw in the distance.



“PROJECTING”

“Am I here? Or there?” Marie asked, while shaking with confusion.

“BOTH”

“Am I dreaming?”

“YOU ARE IN YOUR MIND AND AT THE WALL”

“So my mind is projecting me through the device on

the wall to all of these places we have been? So that was how I was able to stand on an atom!”

“YES”

“OK, so now what?”

“GO TO YOU,” Atlas urged Marie forward, “GO TO YOU”

Marie flew over to her frozen self. She looked at her motionless body, it still had its hand on the square symbol on the wall. Marie saw that her frozen face seemed to be in a dreamlike state.

Standing silently, she looked at every detail of the wall and studied her ‘other’ self. Atlas was pulling her towards the square on the wall.

“HAND”

“Her hand? My hand?” Marie got to within inches of the hand frozen to the wall. “Should I touch her hand?”

“YES”

“Will the projecting stop when I touch the hand?”

“YES”

Marie got closer and placed her hand on top of the frozen hand.



Bubbles started to form around their hands like a carbonated drink, shaken and released. The hands merged together and the two Maries became one Marie. The bubbles tickled her hand and the square symbol began to push into the wall and grow into a massive doorway.

Marie walked through the doorway and realized that she was walking through a portal that brought her to the first oceanic planet. She was excited to think that she was getting to see the world firsthand.

Marie and Atlas were greeted by vast amounts of diverse creatures that were thanking them for their quest. The inhabitants showed them around the planet, including their most precious wonders. Like all the worlds in the solar system they communicated through thought as well.

They had computers and devices similar to the ones that Marie had encountered throughout the mission. She wondered if these creatures were from the ancient civilization that had also been part of her first adventure.

“NO THEY ARE NOT”

One of the creatures from the planet Atlasnia talked to Marie about their freezing and warming. “Our star has always burned out every 100,000 years. Therefore, Ancients left artifacts and tests for Cosmos to ignite our star.”

Marie thought of the Egyptians and other archeological finds on her own planet. She wondered how many other adventures and worlds the Ancients had traveled to and created technology to aid them. Before she could contemplate much more, she was asked to take a tour of the planets that Cosmos had helped.

Marie went on a tour of the first planet. She saw The Living Maelstrom that sucked air deep into the ocean to make bubbles for life to thrive in. She saw the Glowing Reef that shone in every spectrum imaginable and stretched for hundreds of miles. She even saw the ancient Tortoisulino, a turtle-like creature that was bigger than a city. Marie felt like she was so small that she was merely a fleck of dust in his eye.

Once she saw the entire planet Atlasnia, she was brought to a portal and went to the second planet called Ornotholia. There she rode on the giant trees that walked with long strides and had thousands of eyes all over them.

She saw the planet's wonders and enjoyed the different peoples that she met. The birds were excellent musicians and loved hearing some of Marie's songs and rhymes after prompting her to perform. Marie's favorite part was the petrified feather plains, where millions of petrified feathers stood on their tips out of the ground in millions of colors.

She soon said farewell to the Ornotholians and went through another portal that brought her to Nanoparia. Marie was the size of the Nanoparians when she reached the planet. Amazement ensued when she saw how beautiful each blade of grass was and how unique each Nanoparian was. The Nanoparians were similar to salamanders, but with rainbow colors and unique appendages that resembled antennae sticking out of their backs. There was no way for Marie to see all of Nanoparia, but she did fly over a vast area. The planet had particle tubes for fast transportation, taking its residents anywhere on the planet. Marie got to travel through them to see many other areas of the planet. She loved the uniqueness of each Nanoparian. With trillions and trillions of beings, she never saw two alike. The entire planet expressed gratitude with song and lightning shows for Marie and Atlas. They had ignited their star, unfreezing their planets, and brought them out of eternal hibernation – Cosmos, the hero of the solar system.

When they said their farewells, Lodestar pointed them to the last portal. Marie paused for a minute, trying to fathom the true remarkability of the solar system.

Unity

Three planets and nearly infinite life all functioned like one country. They were unified in peace. There were three worlds with a common goal of meeting everyone's needs. When one was hurt, they all were hurt. Compassion was part of the air they breathed.

Marie stood back and reflected on her own adventure and her tests. She took a minute to meditate on the paintings and to realize how well she worked with Atlas. They made a great team. She loved being paired with Atlas as Cosmos.

The portal was the way back home. Marie was speechless as she looked at the swirling circular entry in front of her with . She didn't want to leave Atlas again.

“WE WILL BE COSMOS AGAIN”

“I will be excited for that day. I am so grateful for this adventure, Atlas.” Marie was overjoyed.

“IT'S TIME TO PART”

“Goodbye, Atlas.”

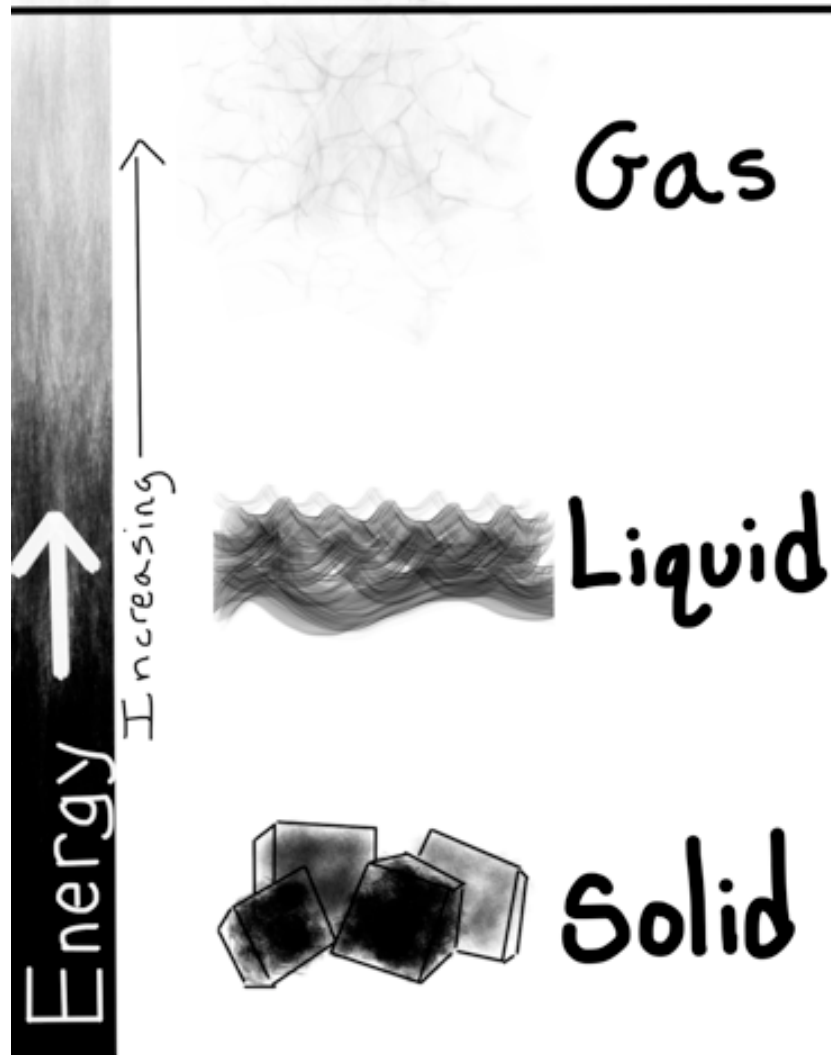
“GOODBYE, MARIE”

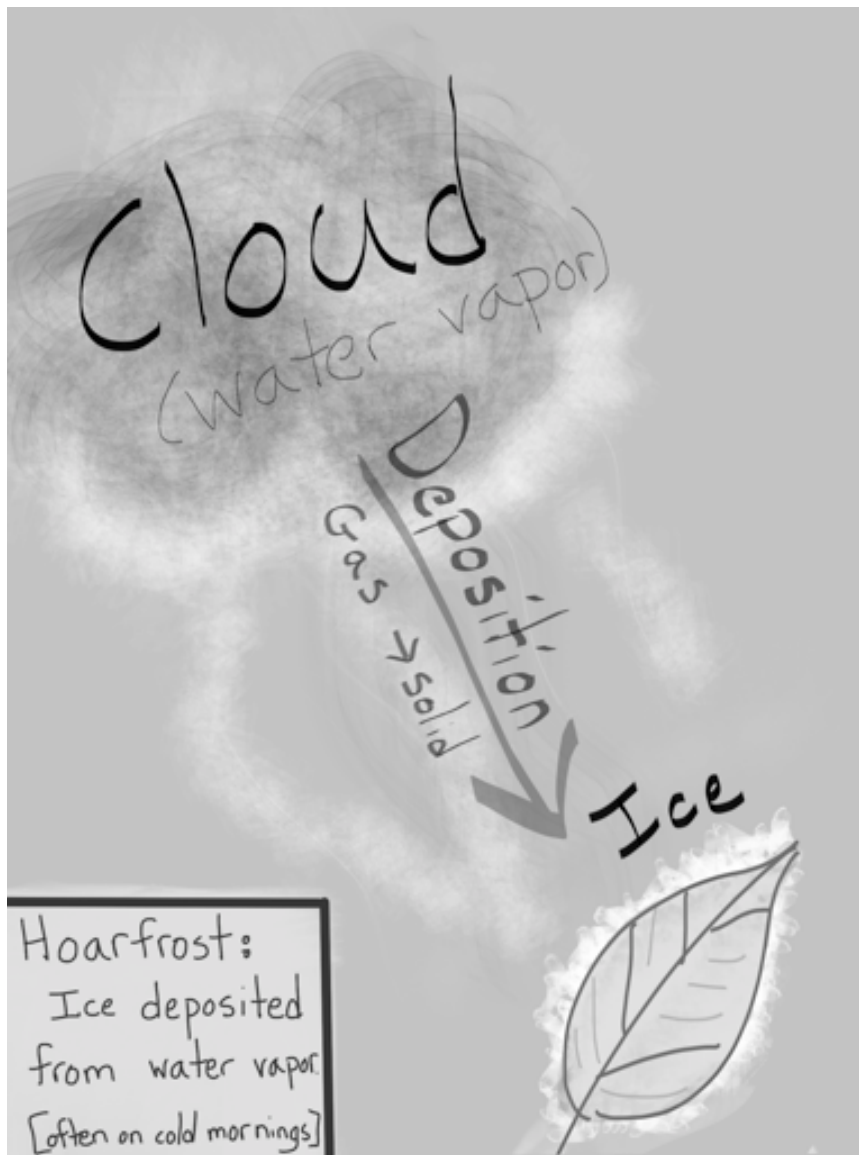
Marie walked through the portal and turned into a beam of particles that shot back to Earth. Marie landed right back in the parking lot that she had left. Her parents were still standing and staring with their jaws dropped. She ran to tell them about her amazing adventure.

More from Marie's Notebook



States of Matter





Opposites
attract...

Pessimist



Optimist

Summation Notation

$$F_n = \sum_{i=1}^n x_i = x_1 + x_2 + x_3 + \dots + x_n$$

number of times

$F_3 = \sum_{i=1}^3 x_i = 1+2+3 = 6$
 $F_4 = \sum_{i=1}^4 x_i = 1+2+3+4 = 10$

Example:

$$F_6 = \sum_{i=1}^6 2x_i = 2 \cdot x_1 + 2 \cdot x_2 + 2 \cdot x_3 + 2 \cdot x_4 + 2 \cdot x_5 + 2 \cdot x_6$$

$$= 2 \cdot 1 + 2 \cdot 2 + 2 \cdot 3 + 2 \cdot 4 + 2 \cdot 5 + 2 \cdot 6$$

$$= 2 + 4 + 6 + 8 + 10 + 12$$

$$= 42$$


$F_n =$
function

Σ

x_i
index

$i=1$ ← start

n ← upper limit



$\Sigma \pi =$


(Sum Pi)

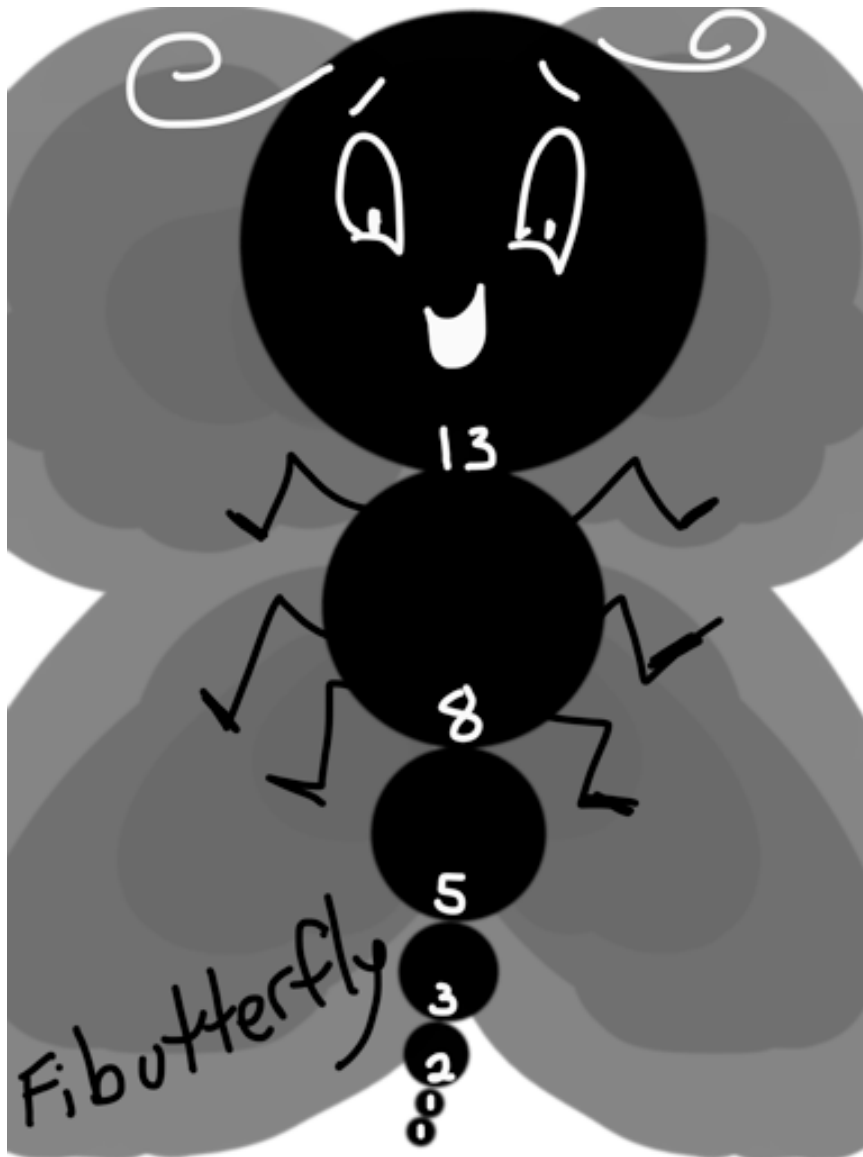
Recipe for Reciprocals

The reciprocal of x is $\frac{1}{x}$

ex:
The reciprocal of 4 is $\frac{1}{4}$

ex:
The reciprocal of  is 





Circle

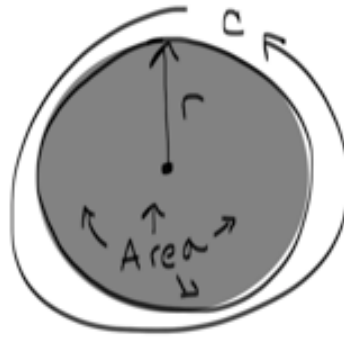
$$\text{Area} = \pi r^2$$

Try this:

$$\pi r^2$$

move $\frac{2}{2} \rightarrow 2\pi r^1$ (2-1) subtract 1

$$2\pi r = C$$



Sphere

$$\text{Volume} = \frac{4}{3} \pi r^3$$

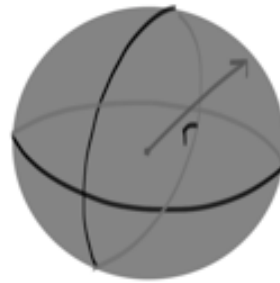
Try this:

$$\frac{4}{3} \pi r^3$$

move $\frac{3}{3} \rightarrow \frac{3 \cdot 4}{3} \pi r^2$ (3-1) subtract 1

$$\frac{3 \cdot 4}{3} \pi r^2$$

$$4\pi r^2 = \text{Area of Surface}$$




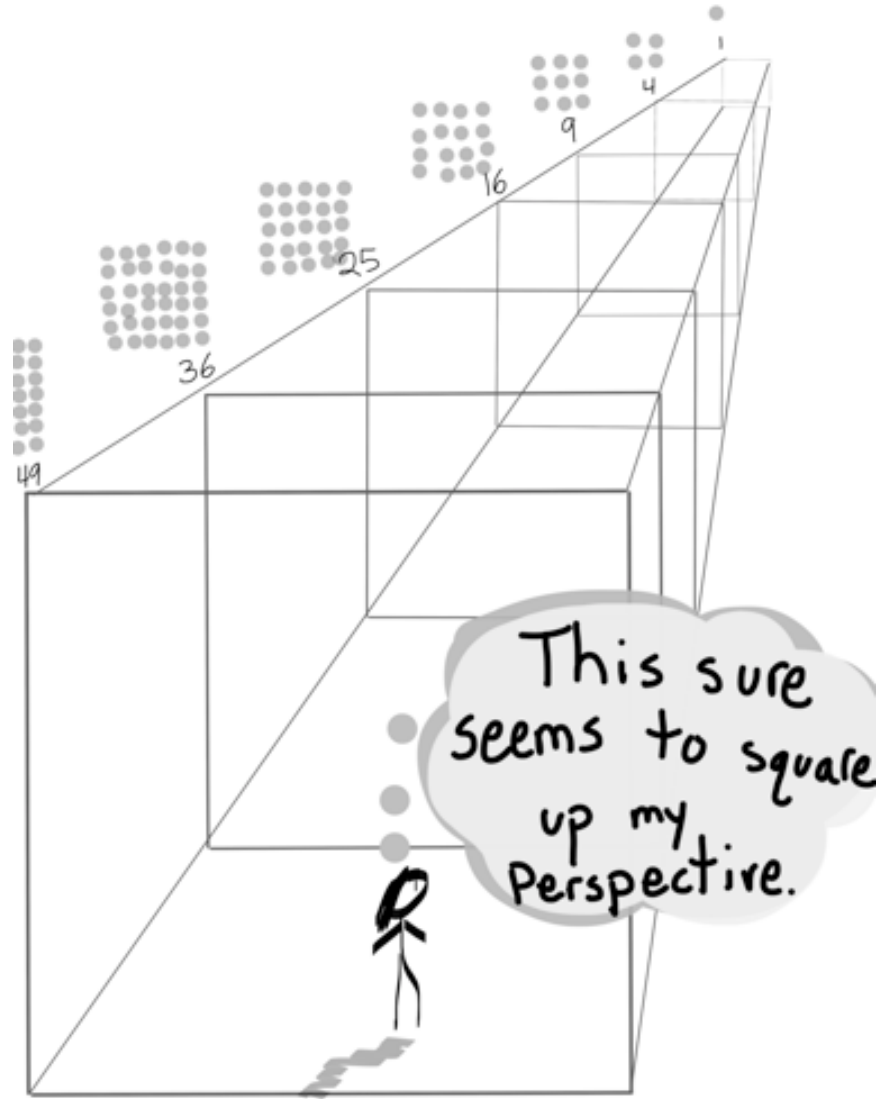
This is in Calculus ☺

Boolean Logic

True or False?
(T or 1) (F or 0)

AND	OR
T AND T = T	T OR T = T
T AND F = F	T OR F = T
F AND T = F	F OR T = T
F AND F = F	F OR F = F

```
IF (I like pie) AND (I like berries)
    Make berry pie 
Else
    No pie
End
```



Marie's Code and More

Python code for Fibonacci sequence:

```
'Print Fibonacci Sequence'  
p = int(input('How many Fibonacci Numbers do you  
want to see? '))  
myFib = []  
myFib.append(0)  
myFib.append(1)  
i = 1  
while i < p-1:  
    i = i + 1  
    myFib.append(myFib[i-2] + myFib[i-1])  
print(myFib)
```


Python code for Circle Facts:

```
'Circle Facts'  
pi = 3.14159265359  
r = float(input('What Radius is your Circle?'))  
d = 2*r  
c = 2*pi*r  
a = pi*r**2  
print('Radius = ',r)  
print('Diameter = ',d)  
print('Circumference = ',c)  
print('Area = ',a)
```

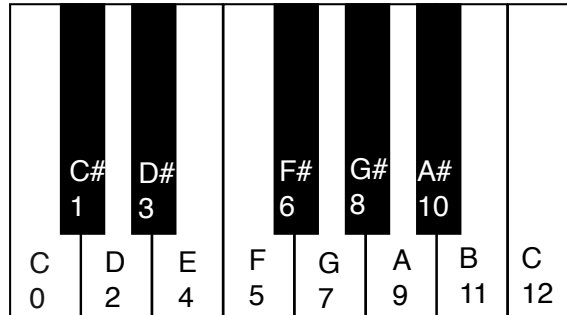
Fibonacci - 13 : Fib Jam

Sophia Wood

k = 13, #P1 = 28



Repeat infinitely



One way of playing Fibonacci on an instrument:

1. Divide each number in the Fibonacci sequence by 13 and get the remainder for each number to create a new set called P.
2. Stop dividing when you get a 0 and then a 1 right after it.
3. You will find that the numbers repeat infinitely.
4. Assign each number in the set that repeats to a key on a piano (or instrument) to create music.

For more information, there is sheet music called “Mod Fibonacci” and other resources on Pisano Periods.

Python Code to print P for a given x (number of keys):

```

'Fibonacci in Music'
'Sophia Wood 2016'
'print P (notes) for any given x'
data = []
myFib = []
myFib.append(0)
myFib.append(1)
i = 1
'Fill in Fibonacci Numbers (fill in more if
required for large keyboards > 300'
while i < 2000:
    i = i + 1
    myFib.append(myFib[i-2] + myFib[i-1])
r = int(input(' input x: '))
notes = []
music = []
'Fill in note array'
notes = []
j = 0
while j < len(myFib) :
    tmp = myFib[j]%r
    notes.append(tmp)
    j = j+1
'find pattern'
music = []
j = 1
music.append(notes[0])
music.append(notes[1])
while j < len(myFib) :
    j = j+1
    if (notes[j - 1] == music[0]) and (notes[j]
== music[1]) :
        'print(j)'
        data.append(j-1)
        j = len(myFib)
    else :
        music.append(notes[j])
print('The set P with |P| = ', len(music) - 1,
'is as follows:')
print(music)

```

