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PROJECT HAIL MARY

'Life-affirming'
The Times

'The ultimate page-turner'
Daily Mail

'Brilliantly enjoyable'
Tim Peake

NOW A MAJOR MOTION PICTURE STARRING RYAN GOSLING

ANDY WEIR

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THE MULTIMILLION-COPY BESTSELLING AUTHOR OF
THE MARTIAN

PENGUIN BOOKS

PROJECT HAIL MARY

Andy Weir built a two-decade career as a software engineer until the success of his first published novel, *The Martian*, allowed him to live out his dream of writing full-time. He is a lifelong space nerd and a devoted hobbyist of such subjects as relativistic physics, orbital mechanics, and the history of manned spaceflight. He also mixes a mean cocktail. He lives in California.

Praise for *Project Hail Mary*

'Brilliantly funny and enjoyable. One of the most plausible science fictions I've ever read.'
TIM PEAKE

'If you like a lot of science in your science fiction, Andy Weir is the writer for you . . . This one has everything fans of old school SF (like me) love.'
GEORGE R. R. MARTIN

'Weir's finest work to date . . . This is the one book I read last year that I am certain I can recommend to anyone, no matter who, and know they'll love it.'
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'One of the most original, compelling, and fun voyages I've ever taken. Weir imbues every page of this rollicking adventure with an unabashed love and respect for science, while giving us a prescient glimpse of where it could take us and how it might save us.'
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‘Andy Weir proves once again that he is a singular talent. *Project Hail Mary* is so fascinating and propulsive that it’s downright addictive. From the first page as Ryland wakes up not knowing who or where he is, I was hooked.’
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DAILY MAIL

‘Life-affirming [and] wonderfully well-conceived.’
THE TIMES

‘The most enjoyable hard SF I have read in years: funny, well plotted and full of surprises.’
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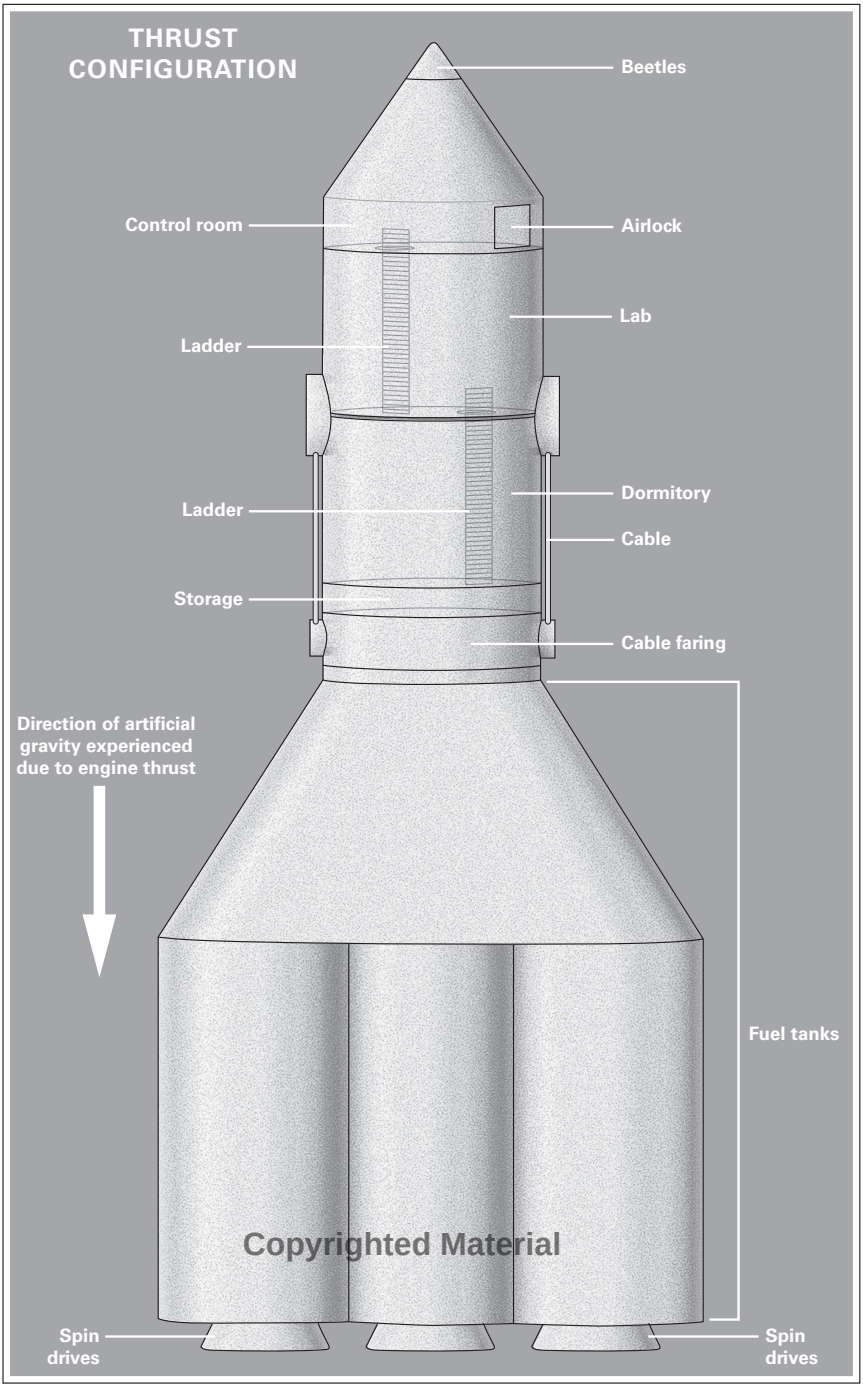

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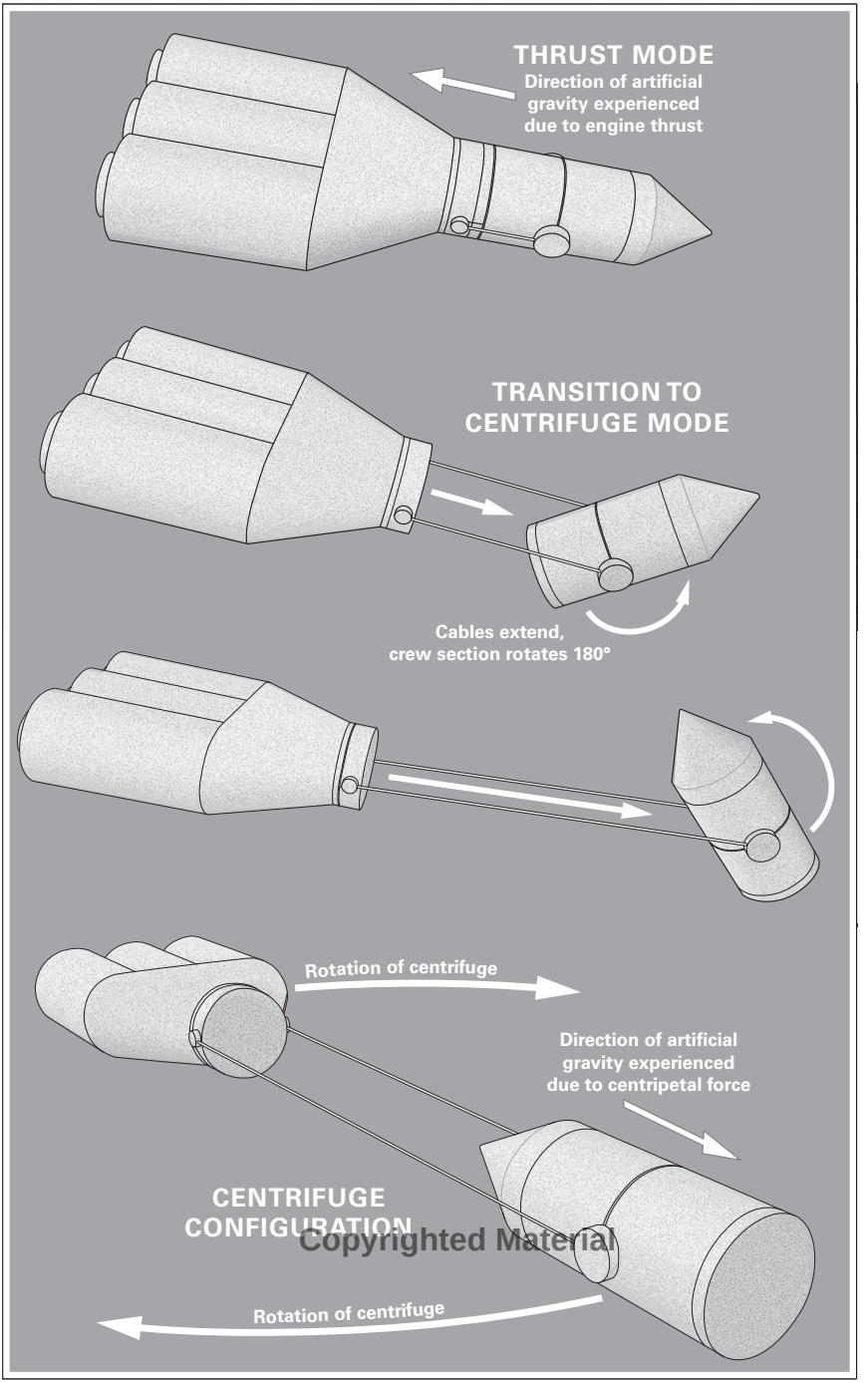

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CHAPTER 1

"What's two plus two?"

Something about the question irritates me. I'm tired. I drift back to sleep.

A few minutes pass, then I hear it again.

"What's two plus two?"

The soft, feminine voice lacks emotion and the pronunciation is identical to the previous time she said it. It's a computer. A computer is hassling me. I'm even more irritated now.

"Lrmln," I say. I'm surprised. I meant to say "Leave me alone"—a completely reasonable response in my opinion—but I failed to speak.

"Incorrect," says the computer. "What's two plus two?"

Time for an experiment. I'll try to say hello.

"Hlllch?" I say.

"Incorrect. What's two plus two?"

What's going on? I want to find out, but I don't have much to work with. I can't see. I can't hear anything other than the computer. I can't even feel. No, that's not true. I feel something. I'm lying down. I'm on something soft. A bed.

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I think my eyes are closed. That's not so bad. All I have to do is open them. I try, but nothing happens.

Why can't I open my eyes?

Open.

Aaaand . . . open!

Open, dang it!

Ooh! I felt a wiggle that time. My eyelids moved. I felt it.

Open!

My eyelids creep up and blinding light sears my retinas.

"Glunn!" I say. I keep my eyes open with sheer force of will. Everything is white with shades of pain.

"Eye movement detected," my tormenter says. "What's two plus two?"

The whiteness lessens. My eyes are adjusting. I start to see shapes, but nothing sensible yet. Let's see . . . can I move my hands? No.

Feet? Also no.

But I can move my mouth, right? I've been saying stuff. Not stuff that makes sense, but it's something.

"Fffr."

"Incorrect. What's two plus two?"

The shapes start to make sense. I'm in a bed. It's kind of . . . oval-shaped.

LED lights shine down on me. Cameras in the ceiling watch my every move. Creepy though that is, I'm much more concerned about the robot arms.

The two brushed-steel armatures hang from the ceiling. Each has an assortment of disturbingly penetration-looking tools where hands should be. Can't say I like the look of that.

"Ffff . . . oooh . . . rrrr," I say. Will that do?

"Incorrect. What's two plus two?"

Dang it. I summon all my willpower and inner strength. Also, I'm starting to panic a little. Good. I use that too.

"Fffoouurr," I finally say.

"Correct."

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Thank God. I can talk. Sort of.

I breathe a sigh of relief. Wait—I just controlled my breathing. I

take another breath. On purpose. My mouth is sore. My throat is sore. But it's *my* soreness. I have control.

I'm wearing a breathing mask. It's tight to my face and connected to a hose that goes behind my head.

Can I get up?

No. But I can move my head a little. I look down at my body. I'm naked and connected to more tubes than I can count. There's one in each arm, one in each leg, one in my "gentlemen's equipment," and two that disappear under my thigh. I'm guessing one of them is up where the sun doesn't shine.

That can't be good.

Also, I'm covered with electrodes. The sensor-type stickers like for an EKG, but they're all over the place. Well, at least they're only on my skin instead of jammed into me.

"Wh—" I wheeze. I try again. "Where . . . am . . . I?"

"What's the cube root of eight?" the computer asks.

"Where am I?" I say again. This time it's easier.

"Incorrect. What's the cube root of eight?"

I take a deep breath and speak slowly. "Two times *e* to the two-*i*-pi."

"Incorrect. What's the cube root of eight?"

But I wasn't incorrect. I just wanted to see how smart the computer was. Answer: not very.

"Two," I say.

"Correct."

I listen for follow-up questions, but the computer seems satisfied.

I'm tired. I drift off to sleep again.

I wake up. How long was I out? It must have been a while because I feel rested. I open my eyes without any effort. That's progress.

I try to move my fingers. They wiggle as instructed. All right. Now we're getting somewhere.

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"Hand movement detected," says the computer. "Remain still."

"What? Why—"

The robot arms come for me. They move *fast*. Before I know it, they've removed most of the tubes from my body. I didn't feel a thing. Though my skin is kind of numb anyway.

Only three tubes remain: an IV in my arm, a tube up my butt, and a catheter. Those latter two are kind of the signature items I wanted removed, but okay.

I raise my right arm and let it fall back to the bed. I do the same for my left. They feel heavy as heck. I repeat the process a few times. My arms are muscular. That doesn't make sense. I assume I've had some massive medical problem and been in this bed for a while. Otherwise, why would they have me hooked up to all the stuff? Shouldn't there be muscle atrophy?

And shouldn't there be doctors? Or maybe the sounds of a hospital? And what's with this bed? It's not a rectangle, it's an oval and I think it's mounted to the wall instead of the floor.

"Take . . ." I trail off. Still kind of tired. "Take the tubes out. . . ."

The computer doesn't respond.

I do a few more arm lifts. I wiggle my toes. I'm definitely getting better.

I tilt my ankles back and forth. They're working. I raise my knees up. My legs are well toned too. Not bodybuilder thick, but still too healthy for someone on the verge of death. I'm not sure how thick they should be, though.

I press my palms to the bed and push. My torso rises. I'm actually getting up! It takes all my strength but I soldier on. The bed rocks gently as I move. It's not a normal bed, that's for sure. As I raise my head higher up, I see the head and foot of the elliptical bed are attached to strong-looking wall mounts. It's kind of a rigid hammock. Weird.

Soon, I'm sitting on my butt tube. Not the most comfortable sensation, but when is a tube up your butt ever comfortable?

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I have a better view of things now. This is no ordinary hospital

room. The walls look plastic and the whole room is round. Stark-white light comes from ceiling-mounted LED lights.

There are two more hammock-like beds mounted to the walls, each with their own patient. We are arranged in a triangle and the roof-mounted Arms of Harassment are in the center of the ceiling. I guess they take care of all three of us. I can't see much of my compatriots—they've sunken into their bedding like I had.

There's no door. Just a ladder on the wall leading to . . . a hatch? It's round and has a wheel-handle in the center. Yeah, it's got to be some kind of hatch. Like on a submarine. Maybe the three of us have a contagious disease? Maybe this is an airtight quarantine room? There are small vents here and there on the wall and I feel a little airflow. It could be a controlled environment.

I slide one leg off over the edge of my bed, which makes it wobble. The robot arms rush toward me. I flinch, but they stop short and hover nearby. I think they're ready to grab me if I fall.

"Full-body motion detected," the computer says. "What's your name?"

"Pfft, seriously?" I ask.

"Incorrect. Attempt number two: What's your name?"

I open my mouth to answer.

"Uh . . ."

"Incorrect. Attempt number three: What's your name?"

Only now does it occur to me: I don't know who I am. I don't know what I do. I don't remember anything at all.

"Um," I say.

"Incorrect."

A wave of fatigue grips me. It's kind of pleasant, actually. The computer must have sedated me through the IV line.

". . . waaaait . . ." I mumble.

The robot arms lay me gently back down to the bed.

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I wake up again. One of the robot arms is on my face. What is it doing?!

I shudder, more shocked than anything else. The arm retracts back to its home in the ceiling. I feel my face for damage. One side has stubble and the other is smooth.

"You were shaving me?"

"Consciousness detected," the computer says. "What's your name?"

"I still don't know that."

"Incorrect. Attempt number two: What's your name?"

I'm Caucasian, I'm male, and I speak English. Let's play the odds. "J–John?"

"Incorrect. Attempt number three: What's your name?"

I pull the IV out of my arm. "Bite me."

"Incorrect." The robot arms reach for me. I roll off the bed, which is a mistake. The other tubes are still connected.

The butt tube comes right out. Doesn't even hurt. The still-inflated catheter yanks right out of my penis. And that *does* hurt. It's like peeing a golf ball.

I scream and writhe on the floor.

"Physical distress," says the computer. The arms give chase. I crawl along the floor to escape. I get under one of the other beds. The arms stop short, but they don't give up. They wait. They're run by a computer. It's not like they'll run out of patience.

I let my head fall back and gasp for breath. After a while, the pain subsides and I wipe tears from my eyes.

I have no idea what's going on here.

"Hey!" I call out. "One of you, wake up!"

"What's your name?" the computer asks.

"One of you *humans,* wake up, please."

"Incorrect," the computer says.

My crotch hurts so bad I have to laugh. It's just so absurd. Plus, the endorphins are kicking in and making me giddy. I look back at the

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catheter by my bunk. I shake my head in awe. That thing went through my urethra. Wow.

And it did some damage on the way out. A little streak of blood sits on the ground. It's just a thin red line of—

I sipped my coffee, popped the last fragment of toast into my mouth, and signaled the waitress for my check. I could have saved money by eating breakfast at home instead of going to a diner every morning. Probably would have been a good idea, considering my meager salary. But I hate cooking and I love eggs and bacon.

The waitress nodded and walked over to the cash register to ring me up. But another customer came in to be seated right that moment.

I checked my watch. Just past seven A.M. No rush. I liked to get in to work by seven-twenty so I could have time to prep for the day. But I didn't actually need to be there until eight.

I pulled out my phone and checked my email.

TO: Astronomy Curiosities astrocurious@scilists.org
FROM: (Irina Petrova, PhD) ipetrova@gaoran.ru
SUBJECT: The Thin Red Line

I frowned at the screen. I thought I'd unsubscribed from that list. I left that life a long time ago. It didn't get a lot of volume, and what it did get, if memory served, was usually pretty interesting. Just a bunch of astronomers, astrophysicists, and other domain experts chatting about anything that struck them as odd.

I glanced at the waitress—the customers had a bunch of questions about the menu. Probably asking if Sally's Diner served gluten-free vegan grass clippings or something. The good people of San Francisco could be trying at times.

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With nothing better to do, I read the email.

Hello, professionals. My name is Doctor Irina Petrova and I work at the Pulkovo Observatory in St. Petersburg, Russia.

I am writing to you to ask for help.

For the past two years, I have been working on a theory related to infrared emissions from nebulae. As a result, I have made detailed observations in a few specific IR bands of light. And I have found something odd—not in any nebula, but here in our own solar system.

There is a very faint, but detectable line in the solar system that emits infrared light at the 25.984 micron wavelength. It seems to be solely that wavelength with no variance.

Attached are Excel spreadsheets with my data. I have also provided a few renders of the data as a 3-D model.

You will see on the model that the line is a lopsided arc that rises straight up from the sun's North Pole for 37 million kilometers. From there, it angles sharply down and away from the sun, toward Venus. After the arc's apex, the cloud widens like a funnel. At Venus, the arc's cross-section is as wide as the planet itself.

The infrared glow is very faint. I was only able to detect it at all because I was using extremely sensitive detection equipment while searching for IR emissions from nebulae.

But to be certain, I called in a favor from the Atacama observatory in Chile—in my opinion the best IR observatory in the world. They confirmed my findings.

There are many reasons one might see IR light in interplanetary space. It could be space dust or other particles reflecting sunlight. Or some molecular compound could be absorbing energy and re-emitting it in the infrared band. That would even explain why it's all the same wavelength.

The shape of the arc is of particular interest. My first guess was that it is a collection of particles moving along magnetic field lines. But Venus has no magnetic field to speak of. No mag-

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netosphere, no ionosphere, nothing. What forces would make particles arc toward it? And why would they glow?

Any suggestions or theories would be welcome.

What the heck was that?

I remembered it all at once. It just kind of showed up in my head without warning.

I didn't learn much about myself. I live in San Francisco—I remember that. And I like breakfast. Also I used to be into astronomy but now I'm not?

Apparently my brain decided it was critical that I remember that email. Not trivial things like *my own name*.

My subconscious wants to tell me something. Seeing the line of blood must have reminded me of the "Thin Red Line" title of that email. But what's that got to do with me?

I shimmy out from under the bed and sit up against the wall. The arms angle toward me, but still can't reach.

Time to get a look at my fellow patients. I don't know who I am or why I'm here, but at least I'm not alone—aaaand they're dead.

Yes, definitely dead. The one closest to me was a woman, I think. At least, she had long hair. Other than that, she's mostly a mummy. Desiccated skin draped over bones. There's no smell. Nothing is actively rotting. She must have died a long time ago.

The person in the other bed was a man. I think he's been dead even longer. His skin is not only dry and leathery but also crumbling away.

Okay. So I'm here with two dead people. I should be disgusted and horrified, but I'm not. They're so far gone they don't even look human. They look like Halloween decorations. I hope I wasn't close friends with either of them. Or, if I was, I hope I don't remember it.

Dead people is a concern, but I'm more concerned that they've been here so long. Even a quarantine area would remove dead people, wouldn't they? Whatever's wrong must be pretty darn bad.

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I get to my feet. It's slow and it takes a lot of effort. I steady myself at the edge of Ms. Mummy's bed. It wobbles and I wobble with it, but I stay upright.

The robot arms make a play for me, but I flatten myself against the wall again.

I'm pretty sure I was in a coma. Yeah. The more I think of it, I was definitely in a coma.

I don't know how long I've been here, but if I was put here at the same time as my roommates it's been a while. I rub my half-shaved face. Those arms are designed to manage long-term unconsciousness. More evidence I was in a coma.

Maybe I can get to that hatch?

I take a step. Then another. Then I sink to the floor. It's just too much for me. I have to rest.

Why am I so weak when I have these well-toned muscles? And if I was in a coma, why do I even have muscles? I should be a withered, spindly mess right now, not beach-bod buff.

I have no idea what my endgame is. What should I do? Am I really sick? I mean, I feel like crud of course, but I don't feel "sick." I'm not nauseated. I don't have a headache. I don't think I have a fever. If I don't have a disease, why was I in a coma? Physical injury?

I feel around my head. No lumps or scars or bandages. The rest of my body seems pretty solid too. Better than solid. I'm ripped.

I want to nod off but I resist it.

Time to take another stab at this. I push myself back up. It's like weightlifting. But it's a little easier this time. I'm recovering more and more (I hope).

I shuffle along the wall, using my back for support as much as my feet. The arms constantly reach for me but I stay out of range.

I pant and wheeze. I feel like I've run a marathon. Maybe I have a lung infection? Maybe I'm in isolation for my own protection?

I finally make it to the ladder. I stumble forward and grab one of the rungs. I'm just so weak. How am I going to climb a 10-foot ladder?

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Ten-foot ladder.

I think in imperial units. That's a clue. I'm probably an American. Or English. Or maybe Canadian. Canadians use feet and inches for short distances.

I ask myself: How far is it from L.A. to New York? My gut answer: 3,000 miles. A Canadian would have used kilometers. So I'm English or American. Or I'm from Liberia.

I know Liberia uses imperial units but I don't know my own name. That's irritating.

I take a deep breath. I hang on to the ladder with both hands and put my foot on the bottom rung. I pull myself up. It's a shaky process, but I get it done. Both feet are on the lower rung now. I reach up and grab the next rung. Okay, making progress. I feel like my whole body is made of lead—everything is so much effort. I try to pull myself up, but my hand just isn't strong enough.

I fall backward off the ladder. This is going to hurt.

It doesn't hurt. The robot arms catch me before I hit the ground because I fell into grabbing range. They don't miss a beat. They return me to bed and settle me in like a mother putting her child to sleep.

You know what? This is fine. I'm really tired at this point and lying down kind of works for me. The gentle rocking of the bed is comforting. Something bugs me about how I fell off the ladder. I replay it in my head. I can't put my finger on it, but there's just a . . . "wrongness" to it.

Hmm.

I drift off.

"Eat."

There's a toothpaste tube on my chest.

"Huh?"

"Eat," the computer says again.

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I lift the tube. It's white with black text that reads DAY 1—MEAL 1.

"The heck is this?" I say.

"Eat."

I unscrew the cap and smell something savory. My mouth waters at the prospect. Only now do I realize how hungry I am. I squeeze the tube and disgusting-looking brown sludge comes out.

"Eat."

Who am I to question a creepy robot-armed computer overlord? I cautiously lick the substance.

Oh my God it's good! It's so good! It's like thick gravy but not too rich. I squeeze more straight into my mouth and savor it. I swear it's better than sex.

I know what's going on here. They say hunger is the greatest seasoning. When you're starving, your brain rewards you handsomely for finally eating. *Good job,* it says, *we get to not die for a while!*

The pieces fall into place. If I was in a coma for a long time, I must have been getting fed. I didn't have an abdominal tube when I woke up, so it was probably feeding me with an NG tube running down my esophagus. It's the least-intrusive way to feed a patient who can't eat but has no digestion issues. Plus, it keeps the digestive system active and healthy. And it explains why the tube wasn't around when I woke up. If possible, you should remove an NG tube while the patient is still unconscious.

Why do I know that? Am I a doctor?

I squeeze another shot of gravy-goo into my mouth. Still delicious. I gobble it down. Soon the tube is empty. I hold it up. "More of this!"

"Meal complete."

"I'm still hungry! Give me another tube!"

"Food allotment for this meal has been met."

It makes sense. My digestive system is getting used to semi-solid food right now. Best to take it easy. If I eat as much as I want I'll probably get sick. The computer is doing the right thing.

"Give me more food!" No one cares about the right thing when they're hungry.

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"Food allotment for this meal has been met."

"Bah."

Still, I feel a ton better than I did before. The food energized me on the spot, plus I've had more rest.

I roll out of bed, ready to make a break for the wall, but the arms don't chase me. I guess I'm allowed out of bed now that I've proven I can eat.

I look down at my naked body. This just doesn't feel right. I know the only other people around are dead, but still.

"Can I have some clothes?"

The computer says nothing.

"Fine. Be that way."

I pull the sheet off the bed and wrap it around my torso a couple of times. I pull one corner over my shoulder from behind my back and tie it to another from the front. Instant toga.

"Self-ambulation detected," says the computer. "What's your name?"

"I am Emperor Comatose. Kneel before me."

"Incorrect."

Time to see what's up that ladder.

I'm a little unsteady, but I start walking across the room. This is a victory in itself—I don't need wobbly beds or walls to cling to. I'm on my own two feet.

I make it to the ladder and grab hold. I don't *need* something to hang on to, but it sure makes life easier. The hatch above looks pretty darn solid. I assume it's airtight. And there's every chance it's locked. But I have to at least try.

I climb up one rung. Tough, but doable. Another rung. Okay, I have the hang of this. Slow and steady.

I make it to the hatch. I hang on to the ladder with one hand and turn the hatch's circular crank with the other. It actually turns!

"Holy moly!" I say.

"Holy moly"? Is that my go-to expression of surprise? I mean, it's okay, I guess. I would have expected something a little less 1950s. What kind of weirdo am I?

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I turn the crank three full rotations and hear a click. The hatch tilts

downward and I get out of the way. It falls open, suspended by its hefty hinge. I'm free!

Sort of.

Beyond the hatch, there's just darkness. A little intimidating, but at least it's progress.

I reach into the new room and pull myself up to the floor. Lights click on as soon as I enter. Presumably the computer's doing.

The room looks to be the same size and shape as the one I left—another round room.

One large table—a lab table from the look of it—is mounted to the floor. Three lab stools are mounted nearby. All around the walls are pieces of lab equipment. All of it mounted to tables or benches that are bolted to the floor. It's like the room is ready for a catastrophic earthquake.

A ladder along the wall leads to another hatch in the ceiling.

I'm in a well-stocked laboratory. Since when do isolation wards let patients into the lab? And this doesn't look like a medical lab, anyway. What the fudge is going on?!

Fudge? Seriously? Maybe I have young kids. Or I'm deeply religious.

I stand to get a better look at things.

The lab has smaller equipment bolted to the table. I see an 8000x microscope, an autoclave, a bank of test tubes, sets of supply drawers, a sample fridge, a furnace, pipettes—wait a minute. Why do I know all those terms?

I look at the larger equipment along the walls. Scanning electron microscope, sub-millimeter 3-D printer, 11-axis milling machine, laser interferometer, 1-cubic-meter vacuum chamber—I know what everything is. And I know how to use it.

I'm a scientist! Now we're getting somewhere! Time for me to use science. *All right, genius brain: come up with something!*

. . . I'm hungry.

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You have failed me, brain.

Okay, well I have no idea why this lab is here or why I'm allowed in. But . . . onward!

The hatch in the ceiling is 10 feet off the ground. It's going to be another ladder adventure. At least I'm stronger now.

I take a few deep breaths and start climbing the ladder. Same as before, this simple act is a massive effort. I may be getting better, but I'm not "well."

Good lord I'm heavy. I make it to the top, but only just.

I situate myself on the uncomfortable bars and push on the hatch's handle. It doesn't budge.

"To unlock hatch, state your name," says the computer.

"But I don't know my name!"

"Incorrect."

I smack the handle with the palm of my hand. The handle doesn't move and now the palm of my hand hurts. So . . . yeah. Not fruitful.

This will have to wait. Maybe I'll remember my name soon. Or find it written somewhere.

I climb back down the ladder. At least, that's my plan. You'd think going down would be easier and safer than going up. But no. No. Instead of gracefully descending the ladder, I put my foot on the next rung down at an awkward angle, lose my grip on the hatch handle, and fall like an idiot.

I flail like an angry cat, reaching out for anything I can grasp. Turns out that's a terrible idea. I fall onto the table and smack a set of supply drawers with my shin. It hurts like a motherfluffer! I cry out, grab my shin in pain, accidentally roll off the table, and fall to the floor.

No robot arms to catch me this time. I land on my back and it knocks the wind out of me. Then, adding insult to injury, the supply-drawer unit falls over, the drawers open, and lab supplies rain down upon me. The cotton swabs aren't a problem. The test tubes just kind of hurt a little (and surprisingly don't shatter). But the tape measure smacks me square in the forehead.

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More stuff clatters down, but I'm too busy holding the growing

welt on my forehead to notice. How heavy is that tape measure? A 3-foot fall off a table left a bump on my head.

"That. Did not work," I say to no one. That whole experience was just ridiculous. Like something out of a Charlie Chaplin movie.

Actually . . . it really was like that. A little too much like that.

That same feeling of "wrongness" strikes me.

I grab a nearby test tube and toss it into the air. It goes up and comes down like it should. But it annoys me. Something about falling objects ticks me off right now. I want to know why.

What do I have to work with? Well, I have an entire laboratory and I know how to use it. But what's readily at hand? I look around at all the junk that fell to the floor. A bunch of test tubes, sample swabs, Popsicle sticks, a digital stopwatch, pipettes, some Scotch tape, a pen . . .

Okay, I may have what I need here.

I get back to my feet and dust off my toga. There's no dust on it—my whole world seems really clean and sterile, but I do the motions just the same.

I pick up the tape measure and take a look. It's metric. Maybe I'm in Europe? Whatever. Then I grab the stopwatch. It's pretty sturdy, like something you'd take on a hike. It has a solid plastic shell with a hard rubber ring around it. Undoubtedly waterproof. But also dead as a doornail. The LCD screen is completely blank.

I press a few buttons, but nothing happens. I turn it over to get a look at the battery compartment. Maybe I can find a drawer with batteries in it if I know what kind it needs. I spot a little red plastic ribbon coming out of the back. I give it a pull and it comes out entirely. The stopwatch beeps to life.

Kind of like "batteries included" toys. The little plastic tab was there to keep the battery from running down before the owner uses it for the first time. Okay, this is a brand-spanking-new stopwatch. Honestly, everything in this lab looks brand-new. Clean, tidy, no signs of wear. Not sure what to make of that.

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I play with the stopwatch for a while until I understand the controls. Pretty simple, really.

I use the tape measure to find out how high the table is. Anyway, the table's underside is 91 centimeters from the floor.

I pick up a test tube. It's not glass. It may be some kind of high-density plastic or something. It certainly didn't break when it fell 3 feet to a hard surface. Anyway, whatever it's made of, it's dense enough for air resistance to be negligible.

I lay it on the table and ready the stopwatch. I push the test tube off the table with one hand and start the stopwatch with the other. I time how long it takes to hit the ground. I get about 0.37 seconds. That's pretty darn fast. I hope my own reaction time isn't skewing the results.

I note the time down on my arm with the pen—I haven't found any paper yet.

I put the test tube back and repeat the test. This time I get 0.33. I do it twenty times total, noting the results, to minimize the effects of my error margin in starting and stopping the timer. Anyway, I end up with an average of 0.348 seconds. My arm looks like a math teacher's chalkboard, but that's okay.

0.348 seconds. Distance equals one-half acceleration times time squared. So acceleration equals two times distance over time squared. These formulas come easily to me. Second nature. I'm definitely skilled at physics. Good to know.

I run the numbers and come up with an answer I don't like. The gravity in this room is too high. It's 15 meters per second when it should be 9.8. That's why things falling "feel" wrong to me. They're falling too fast. And that's why I'm so weak despite these muscles. Everything weighs one and a half times as much as it should.

Thing is, nothing affects gravity. You can't increase or decrease it. Earth's gravity is 9.8 meters per second per second. Period. And I'm experiencing more than that. There's only one possible explanation.

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I'm not on Earth.

CHAPTER 2

Okay, take a breath. Let's not jump to wild conclusions. Yes, the gravity is too high. Work from there and think of *sensible* answers.

I could be in a centrifuge. It would have to be pretty big. But with Earth's gravity providing 1 g, you could have these rooms at an angle running around a track or on the end of a long solid arm or something. Set that spinning and the aggregate centripetal force plus Earth's gravity could be 15 meters per second per second.

Why would someone make a huge centrifuge with hospital beds and a lab in it? I don't know. Would it even be possible? How big would that radius have to be? And how fast would it go?

I think I know how to find out. I need an accurate accelerometer. Dropping things off a table and timing them is all well and fine for rough estimates, but it's only as accurate as my reaction time on hitting the stopwatch. I need something better. And only one thing will do the job: a small piece of string.

I search the lab drawers.

After a few minutes, I have half the drawers open and have found just about every form of lab supplies except string. I'm about to give up when I finally find a spool of nylon thread.

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"Yes!" I pull off a few feet of thread and cut it with my teeth. I tie a loop on one end and tie the other end around the tape measure. The tape measure will be playing the role of "dead weight" in this experiment. Now I just need something to hang it from.

I look above me at the hatch over my head. I climb up the ladder (easier now than ever before) and put the loop over the main latch handle. Then I let the tape measure's weight pull the string taut.

I have a pendulum.

Cool thing about pendulums: The time it takes for one to swing forward and backward—the period—won't change, no matter how wide it swings. If it's got a lot of energy, it'll swing farther and faster, but the period will still be the same. This is what mechanical clocks take advantage of to keep time. That period ends up being driven by two things, and two things only: the length of the pendulum and gravity.

I pull the pendulum to one side. I release it and start the timer. I count cycles as it sways back and forth. It's not exciting. I almost want to fall asleep, but I stay at it.

When I hit the ten-minute mark, the pendulum is barely moving anymore, so I decide that's long enough. Grand total: 346 full cycles in exactly ten minutes.

Onward to phase two.

I measure the distance from the hatch handle to the floor. It's just over two and a half meters. I go back downstairs to the "bedroom." Again, the ladder is no problem. I'm feeling so much better now. That food really did the trick.

"What's your name?" the computer asks.

I look down at my sheet toga. "I am the great philosopher Pendulus!"

"Incorrect."

I hang the pendulum on one of the robot hands near the ceiling. I hope it'll stay still for a while. I eyeball the distance between the robot hand and the ceiling—I'll call it a meter. My pendulum is now four and a half meters lower than it was before.

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I repeat the experiment. Ten minutes on the stopwatch, and I count the total cycles. The result: 346 cycles. Same as upstairs.

Golly.

Thing is, in a centrifuge, the farther you get from the center, the higher the centripetal force will be. So if I were in a centrifuge, the "gravity" down here would be higher than it was upstairs. And it isn't. At least, not enough to get a different number of pendulum cycles.

But what if I'm in a *really big* centrifuge? One so huge that the force difference between here and the lab is so small it doesn't change the number of cycles?

Let's see . . . the formula for a pendulum . . . and the formula for the force of a centrifuge . . . wait, I don't have the actual force, just a cycle count, so there's a one-over-*x* factor involved . . . this is actually a very instructive problem!

I have a pen, but no paper. That's okay—I have a wall. After a lot of "crazy prisoner scribbling on a wall"–type stuff, I have my answer.

Let's say I'm on Earth and in a centrifuge. That would mean the centrifuge provides some of the force with the rest being supplied by Earth. According to my math (and I showed all my work!), that centrifuge would need a 700-meter radius (which is almost half a mile) and would be spinning at 88 meters per second—almost 200 miles per hour!

Hmm. I think mostly in metric when doing science stuff. Interesting. Most scientists do, though, right? Even scientists who grew up in America.

Anyway, that would be the largest centrifuge ever built . . . and why would anyone build it? Plus, something like that would be loud as heck. Whizzing through the air at 200 miles per hour? At the very least there'd be some turbulence here and there, not to mention a lot of wind noise. I don't hear or feel anything like that.

This is getting weird. Okay, what if I'm in space? There wouldn't be turbulence or wind resistance, but the centrifuge would have to be bigger and faster because there's no gravity to help out.

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More math, more graffiti on the wall. The radius would have to be

1,280 meters—close to a mile. Nothing anywhere near that big has ever been built for space.

So I'm not in a centrifuge. And I'm not on Earth.

Another planet? But there isn't any planet, moon, or asteroid in the solar system that has this much gravity. Earth is the largest solid object in the whole system. Sure, the gas giants are bigger, but unless I'm in a balloon floating around the winds of Jupiter, there's just nowhere I could go to experience this force.

How do I know all that space stuff? I just know it. It feels like second nature—information I use all the time. Maybe I'm an astronomer or a planetary scientist. Maybe I work for NASA or ESA or—

I met Marissa every Thursday night for steak and beer at Murphy's on Gough Street. Always at six P.M., and because the staff knew us, always at the same table.

We'd met almost twenty years ago in grad school. She dated my then-roommate. Their relationship (like most in grad school) was a train wreck and they broke up within three months. But she and I ended up becoming good friends.

When the host saw me, he smiled and jerked his thumb toward the usual table. I made my way through the kitschy décor to Marissa. She had a couple of empty lowball glasses in front of her and a full one in her hand. Apparently, she'd gotten started early.

"Pre-gaming, eh?" I said, sitting down.

She looked down and fidgeted with her glass.

"Hey, what's wrong?"

She took a sip of whiskey. "Rough day at work."

I signaled the waiter. He nodded and didn't even come over. He knew I wanted a rib-eye, medium, mashed potatoes on the side, and a pint of Guinness. Same thing I ordered every week.

"How rough could it be?" I asked. "Cushy government job with the DOE. You probably get, what, twenty days off a year? All you have to do is show up and you get paid, right?"

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Again, no laugh. Nothing.

"Oh, come on!" I said. "Who pooped in your Rice Krispies?"

She sighed. "You know about the Petrova line?"

"Sure. Kind of an interesting mystery. My guess is solar radiation. Venus doesn't have a *magnetic* field, but positively charged particles might be drawn there because it's *electrically* neutral—"

"No," she said. "It's something else. We don't know exactly what. But it's something . . . else. But whatever. Let's eat steak."

I snorted. "Come on, Marissa, spill it. What the heck is wrong with you?"

She mulled it over. "Why not? You'll hear it from the president in about twelve hours anyway."

"The president?" I said. "Of the United States?"

She took another gulp of whiskey. "Have you heard of *Amaterasu*? It's a Japanese solar probe."

"Sure," I said. "JAXA has been getting some great data from it. It's really neat, actually. It's in a solar orbit, about halfway between Mercury and Venus. It has twenty different instruments aboard that—"

"Yeah, I know. Whatever," she said. "According to their data, the sun's output is decreasing."

I shrugged. "So? Where are we in the solar cycle?"

She shook her head. "It's not the eleven-year cycle. It's something else. JAXA accounted for the cycle. There's still a downward trend. They say the sun is 0.01 percent less bright than it should be."

"Okay, interesting. But hardly worth three whiskeys before dinner."

She pursed her lips. "That's what I thought. But they're saying that value is increasing. And the *rate* of the increase is increasing. It's some sort of exponential loss that they caught very, very early thanks to their probe's incredibly sensitive instruments."

I leaned back in the booth. "I don't know, Marissa. Spotting an exponential progression that early seems really unlikely. But okay, let's say the JAXA scientists are right. Where's the energy going?"

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"The Petrova line."

"Huh?"

"JAXA took a good long look at the Petrova line and they say it's getting brighter at the same rate that the sun is getting dimmer. Somehow or another, whatever it is, the Petrova line is stealing energy from the sun."

She pulled a sheaf of papers from her purse and put them on the table. It looked like a bunch of graphs and charts. She shuffled through them until she found the one she wanted, then pushed it toward me.

The x-axis was labeled "time" and the y-axis was labeled "luminosity loss." The line was exponential, for sure.

"This can't be right," I said.

"It's right," she said. "The sun's output will drop a full percent over the next nine years. In twenty years that figure will be five percent. This is bad. It's really bad."

I stared at the graph. "That would mean an ice age. Like . . . right away. Instant ice age."

"Yeah, at the very least. And crop failures, mass starvation . . . I don't even know what else."

I shook my head. "How can there be a sudden change in the sun? It's a *star*, for cripes' sake. Things just don't happen this fast for stars. Changes take millions of years, not dozens. Come on, you know that."

"No, I don't know that. I used to know that. Now I only know the sun's dying," she said. "I don't know why and I don't know what we could do about it. But I know it's dying."

"How . . ." I furrowed my brow.

She downed the rest of her drink. "President addresses the nation tomorrow morning. I think they're coordinating with other world leaders to all announce at the same time."

The waiter dropped off my Guinness. "Here you go, sir. The steaks should be out shortly."

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"I need another whiskey," Marissa said.

"Make it two," I added.

I blink. Another flash of memory.

Was it true? Or is that just a random memory of me talking to someone who got sucked into a bogus doomsday theory?

No. It's real. I'm terrified just thinking about it. And it's not just sudden terror. It's a cozy, comfortable terror with a permanent seat at the table. I've felt it for a long time.

This is real. The sun is dying. And I'm tangled up in it. Not just as a fellow citizen of Earth who will die with everyone else—I'm actively involved. There's a sense of responsibility there.

I still don't remember my own name, but I remember random bits of information about the Petrova problem. They call it the Petrova problem. I just remembered that.

My subconscious has priorities. And it's desperately telling me about this. I think my job is to solve the Petrova problem.

. . . in a small lab, wearing a bedsheet toga, with no idea who I am, and no help other than a mindless computer and two mummified roommates.

My vision blurs. I wipe my eyes. Tears. I can't . . . I can't remember their names. But . . . they were my friends. My comrades.

Only now do I realize I've been facing away from them the whole time. I've done everything I can to keep them out of my line of sight. Scrawling on the wall like a madman with the corpses of people I cared about right behind me.

But now the distraction is over. I turn to look at them.

I sob. It comes without warning. I remember bits and pieces all in a rush. She was funny—always quick with a joke. He was professional and with nerves of steel. I think he was military and he was definitely our leader.

I fall to the floor and put my head in my hands. I can't hold anything back. I cry like a child. We were a lot more than friends. And "team" isn't the right word either. It's stronger than that. It's . . .

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It's on the tip of my tongue . . .

Finally, the word slides into my conscious mind. It had to wait until I wasn't looking to sneak in.

Crew. We were a crew. And I'm all that's left.

This is a spacecraft. I know that now. I don't know how it has gravity but it's a spaceship.

Things start to fall into place. We weren't sick. We were in suspended animation.

But these beds aren't magical "freeze chambers" like in the movies. There's no special technology at play here. I think we were in medically induced comas. Feeding tubes, IVs, constant medical care. Everything a body needs. Those arms probably changed sheets, kept us rotated to prevent bedsores, and did all the other things ICU nurses would normally do.

And we were kept fit. Electrodes all over our bodies to stimulate muscle movement. Lots of exercise.

But in the end, comas are dangerous. Extremely dangerous. Only I survived, and my brain is a pile of mush.

I walk over to the woman. I actually feel better, looking at her. Maybe it's a sense of closure, or maybe it's just the calmness that comes after a crying jag.

The mummy has no tubes attached. No monitoring equipment at all. There's a small hole in her leathery wrist. That's where the IV was when she died, I guess. So the hole never healed.

The computer must have removed everything when she died. Waste not, want not, I guess. No point in using resources on dead people. More for the survivors.

More for me, in other words.

I take a deep breath and let it out. I have to be calm. I have to think clearly. I remembered a lot just then—my crew, some aspects of their personalities, that I'm on a spaceship (I'll freak out about that later). The point is I'm getting more memories back, and they're coming sort of when I want them instead of at random intervals. I want to focus on that, but the sadness is just so strong.

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"Eat," says the computer.

A panel in the center of the ceiling opens up, and a food tube drops out. One of the robot arms catches it and places it on my bed. The label reads DAY 1—MEAL 2.

I'm not in the mood to eat, but my stomach growls as soon as I see the tube. Whatever my mental state may be, my body has needs.

I open the tube and squirt goop into my mouth.

I have to admit: It's another incredible flavor sensation. I think it's chicken with hints of vegetable. There's no texture, of course—it's basically baby food. And it's a little thicker than my earlier meal. It's all about getting my digestive system used to solid food again.

"Water?" I say between mouthfuls.

The ceiling panel opens again, this time with a metal cylinder. An arm brings it to me. Text on the shiny container reads POTABLE WATER. I unscrew the top and, sure enough, there's water in there.

I take a sip. It's room temperature and tastes flat. It's probably distilled and devoid of minerals. But water's water.

I finish the rest of my meal. I haven't had to use a bathroom yet but I'll need to eventually. I'd rather not go wee on the floor.

"Toilet?" I say.

A wall panel spins around to reveal a metal commode. It's just right there in the wall, like in a prison cell. I take a closer look. It has buttons and stuff on it. I think there's a vacuum pipe in the bowl. And there's no water. I think this might be a zero-g toilet modified for use in gravity. Why do that?

"Okay, uh . . . dismiss toilet."

The wall swivels around again. The toilet is gone.

All right. I'm well fed. I'm feeling a little better about things. Food will do that.

I need to focus on some positives. I'm alive. Whatever killed my friends, it didn't kill me. I'm on a spaceship—I don't know the details, but I know I'm on a ship and it seems to be working correctly.

And my mental state is improving. I'm sure of it.

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I sit cross-legged on the floor. It's time for a proactive step. I close my eyes and let my mind wander. I want to remember something—

anything—on purpose. I don't care what. But I want to initiate it. Let's see what I get.

I start with what makes me happy. I like science. I know it. I got a thrill from all the little experiments I've been doing. And I'm in space. So maybe I can think about space and science and see what I get. . . .

I pulled the piping-hot spaghetti TV dinner from the microwave and hustled over to my couch. I peeled the plastic off the top to let the steam escape.

I unmuted the TV and listened to the live feed. Several coworkers and a few friends had invited me to watch this with them, but I didn't want to spend the whole evening answering questions. I just wanted to watch in peace.

It was the most watched event in human history. More than the moon landing. More than any World Cup Final. Every network, streaming service, news website, and local TV affiliate was showing the same thing: NASA's live feed.

A reporter stood with an older man in the gallery of a flight-control room. Beyond them, men and women in blue shirts fixed their attention on their terminals.

"This is Sandra Elias," said the reporter. "I'm here at the Jet Propulsion Laboratory in Pasadena, California. I'm here with Dr. Browne, who is the head of Planetary Sciences for NASA."

She turned to the scientist. "Doctor, what's our status now?"

Browne cleared his throat. "We received confirmation about ninety minutes ago that *ArcLight* successfully inserted into orbit around Venus. Now we're just waiting for that first batch of data."

It had been a heck of a year since the JAXA announcement about the Petrova problem. But study after study confirmed their findings. The clock was ticking and the world needed to find out what was going on. So Project ArcLight was born.

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The situation was terrifying, but the project itself was awesome. My inner nerd couldn't help but be excited.

ArcLight was the most expensive unmanned spacecraft ever built. The world needed answers and didn't have time to dillydally. Normally if you asked a space agency to send a probe to Venus in under a year, they'd laugh in your face. But it's amazing what you can do with an unlimited budget. The United States, European Union, Russia, China, India, and Japan all helped cover costs.

"Tell us about going to Venus," the reporter said. "What makes it so hard?"

"The main problem is fuel," said Browne. "There are specific transfer windows when interplanetary travel takes the minimum amount of fuel, but we were nowhere near an Earth-Venus window. So we had to put a lot more fuel in orbit just to get *ArcLight* there in the first place."

"So it's a case of bad timing, then?" the reporter asked.

"I don't think there's ever a good time for the sun to get dimmer."

"Good point. Please go on."

"Venus moves very fast compared to Earth, which means more fuel just to catch up. Even under ideal conditions, it actually takes more fuel to get to Venus than it does to get to Mars."

"Amazing. Amazing. Now, Doctor, some people have asked, 'Why bother with the planet? The Petrova line is huge, spanning an arc from the sun to Venus. Why not somewhere between?'"

"Because the Petrova line is widest there—as wide as the whole planet. And we can use the planet's gravity to help us out. *ArcLight* will actually orbit Venus twelve times while collecting samples of whatever material the Petrova line is made of."

"And what is that material, you think?"

"We have no idea," said Browne. "No idea at all. But we might have answers soon. Once *ArcLight* finishes this first orbit, it should have enough material for its onboard analysis lab."

"And what can we expect to learn tonight?"

"Not much. The onboard lab is pretty basic. Just a high-magnification microscope and an x-ray spectrometer. The real mission here is sample return. It'll be another three months for *ArcLight* to come home

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with those samples. The lab is a backup to get at least some data in case there's a failure during the return phase."

"Good planning as always, Dr. Browne."

"It's what we do."

A cheer erupted from behind the reporter.

"I'm hearing—" She paused to let the sound die down. "I'm hearing that the first orbit is complete and the data is coming in now. . . ."

The main screen in the control room changed to a black-and-white image. The picture was mostly gray, with black dots scattered here and there.

"What are we looking at, Doctor?" said the reporter's voice.

"This is from the internal microscope," said Browne. "It's magnified ten thousand times. Those black dots are about ten microns across."

"Are those dots what we've been looking for?" she asked.

"We can't be certain," said Browne. "They could just be dust particles. Any major gravity source like a planet will have a cloud of dust surrounding—"

"What the fuck?!" came a voice in the background. Several flight controllers gasped.

The reporter snickered. "High spirits here at JPL. We are coming to you live, so we apologize for any—"

"Oh my God!" said Browne.

On the main screen, more images came through. One after another. All nearly the same.

Nearly.

The reporter looked at the images on-screen. "Are those particles . . . moving?"

The images, playing in succession, showed the black dots deforming and shifting around within their environment.

The reporter cleared her throat and delivered what many would call the understatement of the century. "They look a little like microbes, wouldn't you say?"

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"Telemetry!" Dr. Browne called out. "Any shimmy in the probe?"

"Already checked," said someone. "No shimmy."

"Is there a consistent direction of travel?" he asked. "Something that could be explained by an external force? Magnetic, maybe? Static electricity?"

The room fell silent.

"Anyone?!" said Browne.

I dropped my fork right into my spaghetti.

Is this actually alien life? Am I really that lucky?! To be alive when humanity first discovers extraterrestrial life?!

Wow! I mean—the Petrova problem is still terrifying but . . . wow! Aliens! This could be aliens! I couldn't wait to talk about this with the kids tomorrow—

"Angular anomaly," the computer says.

"Darn it!" I say. "I was almost there! I almost remembered myself!"

"Angular anomaly," the computer repeats.

I unfold myself and get to my feet. In my limited interactions with it, the computer seems to have some understanding of what I say. Like Siri or Alexa. So I'll talk to it like I'd talk to one of them.

"Computer, what is an angular anomaly?"

"Angular anomaly: an object or body designated as critical is not at the expected location angle by at least 0.01 radians."

"What body is anomalous?"

"Angular anomaly."

Not much help. I'm on a ship, so it must be a navigational issue. That can't be good. How would I even steer this thing? I don't see anything resembling spaceship controls—not that I really know what those look like. But all I've discovered so far is a "coma room" and a lab.

That other hatch in the lab—the one that leads farther up—that must be important. This is like being in a video game. Explore the area until you find a locked door, then look for the key. But instead of searching bookshelves and garbage cans, I have to search my mind. Because the "key" is my own name.

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The computer's not being unreasonable. If I can't remember my own name, I probably shouldn't be allowed into delicate areas of the ship.

I climb onto my bunk and lie on my back. I keep a wary eye on the robot arms above, but they don't move. I guess the computer is satisfied that I'm self-sufficient for now.

I close my eyes and focus on that flash of memory. I can see bits and pieces of it in my mind. Like looking at an old photo that's been damaged.

I'm in my house . . . no . . . apartment. I have an apartment. It's tidy, but small. There's a picture of the San Francisco skyline on one wall. Not useful. I already know I lived in San Francisco.

There's a Lean Cuisine microwave meal on the coffee table in front of me. Spaghetti. The heat still hasn't equalized yet, so there are pockets of nearly frozen noodles next to tongue-melting plasma. But I'm taking bites anyway. I must be hungry.

I'm watching NASA on TV; I see all that stuff from my previous flash of memory. My first thought is . . . I'm elated! Could it be extraterrestrial life? I can't wait to tell the kids!

I have kids? This is a single man's apartment with a single man eating a single man's meal. I don't see anything feminine at all. There's nothing to suggest a woman in my life. Am I divorced? Gay? Either way, there's no sign that children live here. No toys, no pictures of kids on the wall or mantel, nothing. And the place is way too clean. Kids make a mess of everything. Especially when they start chewing gum. They all go through a gum phase—at least, a lot of them do—and they leave it everywhere.

How do I know that?

I like kids. Huh. Just a feeling. But I like them. They're cool. They're fun to hang out with.

So I'm a single man in my thirties, who lives alone in a small apartment, I don't have any kids, but I like kids a lot. I don't like where this is going . . .

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A teacher! I'm a schoolteacher! I remember it now!

Oh, thank God. I'm a teacher.

CHAPTER 3

"All right," I said, looking at the clock. "We have one minute until the bell. You know what that means!"

"Lightning round!" yelled my students.

Life had changed surprisingly little since the announcement about the Petrova line.

The situation was dire and deadly, but it was also the norm. Londoners during the Blitz in World War II went about their day as normal, with the understanding that occasionally buildings get blown up. However desperate things were, someone still had to deliver milk. And if Mrs. McCreedy's house got bombed in the night, well, you crossed it off the delivery list.

So it was that with the apocalypse looming—possibly caused by an alien life-form—I stood in front of a bunch of kids and taught them basic science. Because what's the point of even having a world if you're not going to pass it on to the next generation?

The kids sat in neat rows of desks, facing the front. Pretty standard stuff. But the rest of the room was like a mad scientist's lab. I'd spent years perfecting the look. I had a Jacob's ladder in one corner (I kept it unplugged so the kids didn't kill themselves). Along another wall was a bookshelf full of specimen jars of animal parts in formalde-

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hyde. One of the jars was just spaghetti and a boiled egg. The kids speculated on that one a lot.

And gracing the center of the ceiling was my pride and joy—a huge mobile that was a model of the solar system. Jupiter was the size of a basketball, while wee Mercury was as small as a marble.

It had taken me years to cultivate a rep as the "cool" teacher. Kids are smarter than most people think. And they can tell when a teacher actually cares about them as opposed to when they're just going through the motions. Anyway, it was time for the lightning round!

I grabbed a fistful of beanbags off my desk. "What is the actual name of the North Star?"

"Polaris!" said Jeff.

"Correct!" I threw a beanbag to him. Before he even caught it, I fired off the next question. "What are the three basic kinds of rocks?"

"Igneous, sedentary, and metamorphic!" yelled Larry. He was excitable, to say the least.

"So close!" I said.

"Igneous, *sedimentary,* and metamorphic," said Abby with a sneer. Pain in the ass, that one. But smart as a whip.

"Yes!" I threw her a beanbag. "What wave do you feel first during an earthquake?"

"The P-wave," Abby said.

"You again?" I threw her a beanbag. "What's the speed of light?"

"Three times ten to—" Abby began.

"C!" yelled Regina from the back. She rarely spoke up. Good to see her coming out of her shell.

"Sneaky, but correct!" I chucked her a beanbag.

"I was answering first!" Abby complained.

"But she *finished* her answer first," I said. "What's the nearest star to Earth?"

"Alpha Centauri!" Abby said quickly.

"Wrong!" I said.

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"No, I'm not!"

"Yes, you are. Anyone else?"

"Oh!" Larry said. "It's the sun!"

"Right!" I said. "Larry gets the beanbag! Careful with your assumptions, Abby."

She folded her arms in a huff.

"Who can tell me the radius of Earth?"

Trang raised his hand. "Three thousand, nine hundre—"

"Trang!" Abby said. "The answer is Trang."

Trang froze in confusion.

"What?" I asked.

Abby preened. "You asked *who could tell you* the radius of Earth. Trang can tell you. I answered correctly."

Outsmarted by a thirteen-year-old. Wasn't the first time. I dropped a beanbag on her desk just as the bell rang.

The kids leapt from their chairs and collected their books and backpacks. Abby, flush with victory, took a little more time than the others.

"Remember to cash in your beanbags at the end of the week for toys and other prizes!" I said to their retreating backs.

Soon, the classroom was empty, and only the echoing sounds of children in the hallway suggested any evidence of life. I collected their homework assignments from my desk and slipped them into my valise. Sixth period was over.

Time to hit the teachers' lounge for a cup of coffee. Maybe I'd correct some papers before I headed home. Anything to avoid the parking lot. A fleet of helicopter moms would be descending on the school to pick up their children. And if one of them saw me, they *always* had some complaint or suggestion. I can't fault someone for loving their kids, and God knows we could do with more parents being engaged in their kids' educations, but there's a limit.

"Ryland Grace?" said a woman's voice.

I looked up with a start. I hadn't heard her come in.

She looked to be in her mid-forties, wearing a well-tailored business suit. She carried a briefcase.

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"Uh, yeah," I said. "Can I help you with something?"

"I think you can," she said. She had a slight accent. Something European—I couldn't quite put my finger on it. "My name is Eva Stratt. I'm with the Petrova Taskforce."

"The what?"

"The Petrova Taskforce. It's an international body set up to deal with the Petrova-line situation. I've been tasked with finding a solution. They've given me a certain amount of authority to get things done."

"They? Who's they?"

"Every member nation of the UN."

"Wait, what? How did—"

"Unanimous secret vote. It's complicated. I'd like to talk to you about a scientific paper you wrote."

"Secret vote? Never mind." I shook my head. "My paper-writing days are over. Academia didn't work well for me."

"You're a teacher. You're still in academia."

"Well, yeah," I said. "But I mean, you know, *academia*. With scientists and peer review and—"

"And assholes who get you kicked out of your university?" She raised an eyebrow. "And who got all your funding cut off and ensured you never got published again?"

"Yeah. That."

She pulled a binder out of her briefcase.

She opened it and read the first page. "'An Analysis of Water-Based Assumptions and Recalibration of Expectations for Evolutionary Models.'" She looked up at me. "You wrote this paper, yes?"

"I'm sorry, how did you get—"

"A dull title, but very exciting content, I have to say."

I set my valise on my desk. "Look, I was in a bad place when I wrote that, okay? I'd had enough of the research world and that was sort of a 'kiss-my-butt' goodbye. I'm much happier now as a teacher."

She flipped a few pages. "You spent years combating the assumption that life requires liquid water. You have an entire section here called 'The Goldilocks Zone Is for Idiots.' You call out dozens of emi-

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nent scientists by name and berate them for believing a temperature range is a requirement."

"Yeah, but—"

"Your doctorate is in molecular biology, correct? Don't most scientists agree that liquid water is necessary for life to evolve?"

"They're wrong!" I crossed my arms. "There's nothing magical about hydrogen and oxygen! They're required for *Earth* life, sure. But another planet could have completely different conditions. All life needs is a chemical reaction that results in copies of the original catalyst. And you don't need water for that!"

I closed my eyes, took a deep breath, and let it out. "Anyway, I got mad, and I wrote that paper. Then I got a teaching credential, a new career, and started actually enjoying my life. So I'm glad no one believed me. I'm better off."

"I believe you," she said.

"Thanks," I said. "But I have papers to grade. Can you tell me why you're here?"

She put the binder back in her briefcase. "You are aware of the *ArcLight* probe and the Petrova line, I assume."

"I'd be a pretty lame science teacher if I wasn't."

"Do you think those dots are alive?" she asked.

"I don't know—they could just be dust bouncing around in magnetic fields. I guess we'll find out when *ArcLight* gets back to Earth. That's coming up, right? Just a few weeks from now?"

"It returns on the twenty-third," she said. "Roscosmos will recover it from low-Earth orbit with a dedicated Soyuz mission."

I nodded. "Then we'll know soon enough. The most brilliant minds in the world will look at them and find out what they're about. Who's going to do that? Do you know?"

"You," she said. "You're going to do it."

I stared blankly.

She waved her hand in front of my face. "Hello?"

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"You want *me* to look at the dots?" I said.

"Yes."