

## EDUCATIONAL GUIDE for



# THE UPPER WORLD

TIME WAITS FOR NO ONE. UNTIL NOW . . .

FEMI FADUGBA

Ages 12-18

@Librarians

Activities to engage both reluctant & eager readers

@English Teachers

Tools & tests to elevate your students' creative writing & comprehension

@Physics Teachers

Mini stories to hook students into your next physics lesson

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## About the Author



Femi Fadugba is a YA sci-fi writer, EdTech CEO, and Dummett Fellow at Oxford University. He's given talks to over 10,000 students on topics ranging from quantum physics to novel writing.

Femi previously worked as a STEM tutor, consultant and solar salesman, having studied at UPenn and Oxford, where he published in Quantum Computing.

His debut novel, *The Upper World*, is coming soon to Netflix with his sequel, *The Mirror World*, published by Penguin Random House in April 2025.

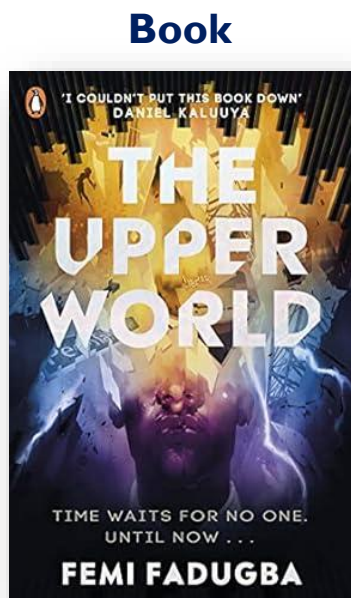


# @Librarians



## + For the Reluctant Reader: Turn them into a Rave Reviewer

1. **Recruit:** Ask your reluctant reader to review chapter 15 of *The Upper World*
2. **Quote:** Dig for their honest reactions & thoughts (e.g. ask what they think the character is going through in the scene) and note down their words.
3. **Print:** Make a mini-poster that combines the book + photo + quote (see template below)
4. **Go public:** Pin the poster near the checkout desk or on the library insta (with their approval)
5. **Reward the risk:** Consider gifting them the book to keep them reading!



**Reader**

**Quote**



# @Librarians



+ For that Kid who Complains about every book: Call their Bluff!

1. **First-chapter test:** Have them review Chapter 1 of *The Mirror World*
2. **Pinpoint the “ugh” moment:** When they moan, ask exactly which part turned them off
3. **Flip the script:** Challenge them to **rewrite that chunk** and make it their own (funnier? scarier? cleverer?)
4. **Mirror display:** Post their rewrite side-by-side with the original—a mirror image! (see template below)



Original text from  
**The Mirror World**



New (& improved!) version by

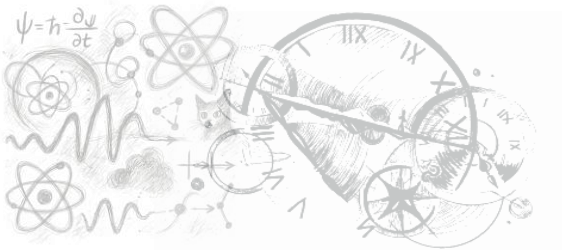
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# @Librarians



## + For the Kids Craving a Challenge: Start a Competition!

1. Form a “Quantum Challenge” group (2–4 students)
2. Have the whole group read *The Mirror World* within **two weeks**
3. **Meet up** and tackle questions such as:
  - *What exactly is quantum physics? How does a quantum computer differ from a regular one?*
  - *How does quantum tech shape the society in the story?*
  - *Why do the tech owners in the book face ethical dilemmas?*
  - *Who should decide which technologies get used? Who’s left out?*
  - *What responsibilities do users—and creators—have?*
4. Each student fills a **1-pager** on their own quantum tech (see next page)
5. Vote on the best & **celebrate** the winner(s)!



# @Librarians



## QUANTUM CHALLENGE: *Using Tech For Good*

**Context:** how would you explain the key principles of quantum physics / computing to a newbie?

**Need:** what problem will your quantum tech address?

**Solution:** how will your specific tech solve this?

**Impact:** who benefits most from your tech? How much?

**Risk:** how could your tech be used for evil? How could you mitigate this?



# @Librarians



## + For the solitary bookworm: Launch a mini-Book Club!

1. Print & trim the Book Club Invite template (see right)
2. Help the book-lover fill in a:
  - Club name (e.g., Lit Happens or The Page Turn-Up)
  - Schedule (e.g., once per month or fortnight)
  - Meeting spot (library corner, empty classroom, nearby park)
  - First book (maybe *The Upper World* or *The Mirror World*?)
  - Starter question (“e.g. who in the book annoys you most?”)
  - RSVP contact details (“Text/DM me by \_\_\_ if you’re in!”)
3. Challenge them to invite one new person—friend or even a teacher—and to grow the circle each time they meet.

## Book Club!

**When:**

**Where:**

**Next book:**

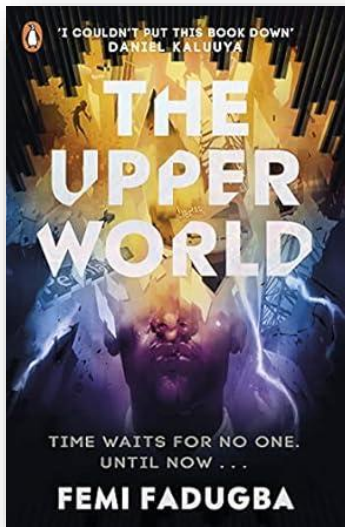
**Starter question:**

**Let us know @:**

# @Librarians

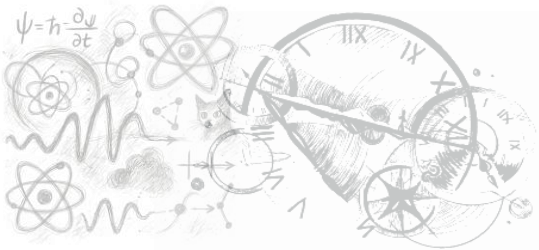


## Word Search for:



- Destiny
- Free Will
- Perspective
- Memory
- Mystery
- Violence
- Knowledge
- Connection
- Belief
- Fear
- Death
- Love
- Forgiveness

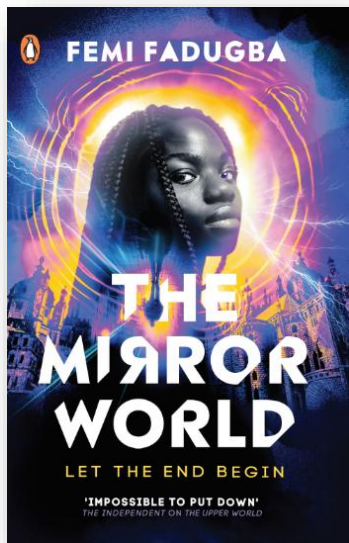
E H E M B H L N M Y S T E R Y  
 F F Q N W J N F X F Z V H J I  
 E T Y X F I V O Z E D N D X E  
 A Y P K P E D Y L D T N P U D  
 R S V P Z C O N N E C T I O N  
 P I I A K M C A N N U Y J V U  
 T E U D D N K D R P O U I N A  
 M B R F E Z O N G V W M Q C S  
 F X G S O S H W B I F X E J G  
 O N G M P R T S L J S O R G K  
 H V Q D E E G I B E B N N V O  
 F E V K D M C I N N D V N U V  
 D E U H H L O T V Y Q G J N I  
 A N S J R B O R I E G H E O O  
 Q H K K Q A E V Y V N N T A L  
 R F R A I Y R L E S E E M D E  
 V A D E A T H T I F U J S U N  
 H E Q L O C T M Y E Y F V S C  
 X Z Q Z V A P M M R F T C C E  
 T Q F R E E W I L L C L V T J



# @Librarians

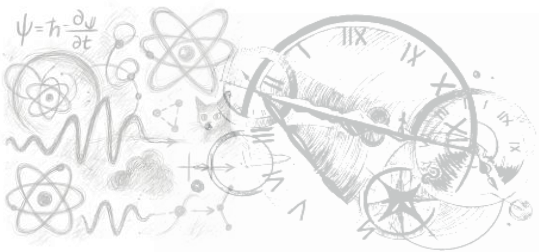


## Word Search for:



- Identity
- Choice
- Environment
- Transformation
- Paradox
- Class
- Knowledge
- Deception
- Power
- Nihilism
- Faith
- Rebirth
- Purpose

W Q O R I X K E U M F V S N E  
 M B L X E D Q W D X C G L C N  
 G F J M R B E J M V I E T L V  
 K G D B S Q I N X G G P R W I  
 N P P T D C H R T I T D A A R  
 O O G A S F D Z T I E S N S O  
 W W U T R P J F Y H T S S B N  
 L E U Z C A P A A K F Y F R M  
 E R L A E H D W E I O K O P E  
 D Y H D J L V O G M T U R T N  
 G D M C N L K S X G R H M W T  
 E K E V P I I V B Q S E A X R  
 G D D C C U H K S H P U T M D  
 J N M K E M R I N R L U I L C  
 K R N K V P G P L W G U O D H  
 B T H T F C T W O I D Q N P O  
 H Z G X C W L I G S S V N K I  
 E D B P M I I A O T E M Q S C  
 W W F B D Y K S S N H U V B E  
 U P V P V A Y Q H S U G Q F Q



# @English Teachers

\*Special thanks to Lucy Freeland of Westminster School for creating this template



## English Comprehension + Creative Writing assignment: *The Upper World*

30 minutes – 30 marks

1. Read the excerpt from *The Upper World* by Femi Fadugba (2021) [see Appendix: Excerpt 11] and answer questions 2 and 3 below.
2. Define the following words, as used in the context of the text [5 marks]:
  - i. *Tragedy*
  - ii. *Granules*
  - iii. *Multiplicity*
  - iv. *Sustenance*
  - v. *Crevice*
3. Write a piece responding to **one** of the three prompts below [25 marks].
 

**Note:** You will be assessed on your ability to write imaginatively, with a range of expression, shaping overall structure effectively. Spelling, punctuation, and grammatical accuracy are assessed in this piece. Take time to plan before you begin

  1. *Write about a moment where time stood still.*
  2. *Write a short story which takes 'The Upper World' as its title.*
  3. *Describe being guided to a 'window' of greater understanding.*

# @English Teachers

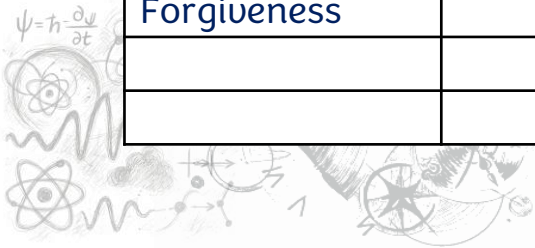


## Theme Sheet: *The Upper World*

*The Upper World* contains many themes (i.e. important ideas lying beneath the surface):

- If you haven't yet read the book, use the below to record ideas on each theme as you read.
- If you've read the book, summarize your notes on each theme below.

Theme	Notes
Destiny	
Free Will	
Perspective	
Memory	
Mystery	
Violence	
Knowledge	
Connection	
Belief	
Fear	
Death	
Love	
Forgiveness	



# @English Teachers

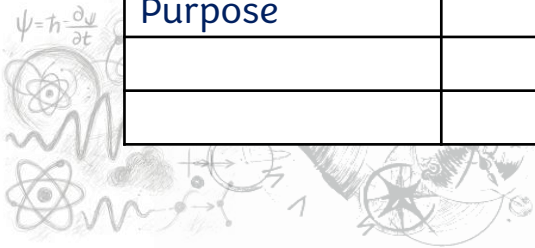


## Theme Sheet: *The Mirror World*

*The Mirror World* contains many themes (i.e. important ideas lying beneath the surface):

- If you haven't yet read the book, use the below to record ideas on each theme as you read.
- If you've read the book, summarize your notes on each theme below.

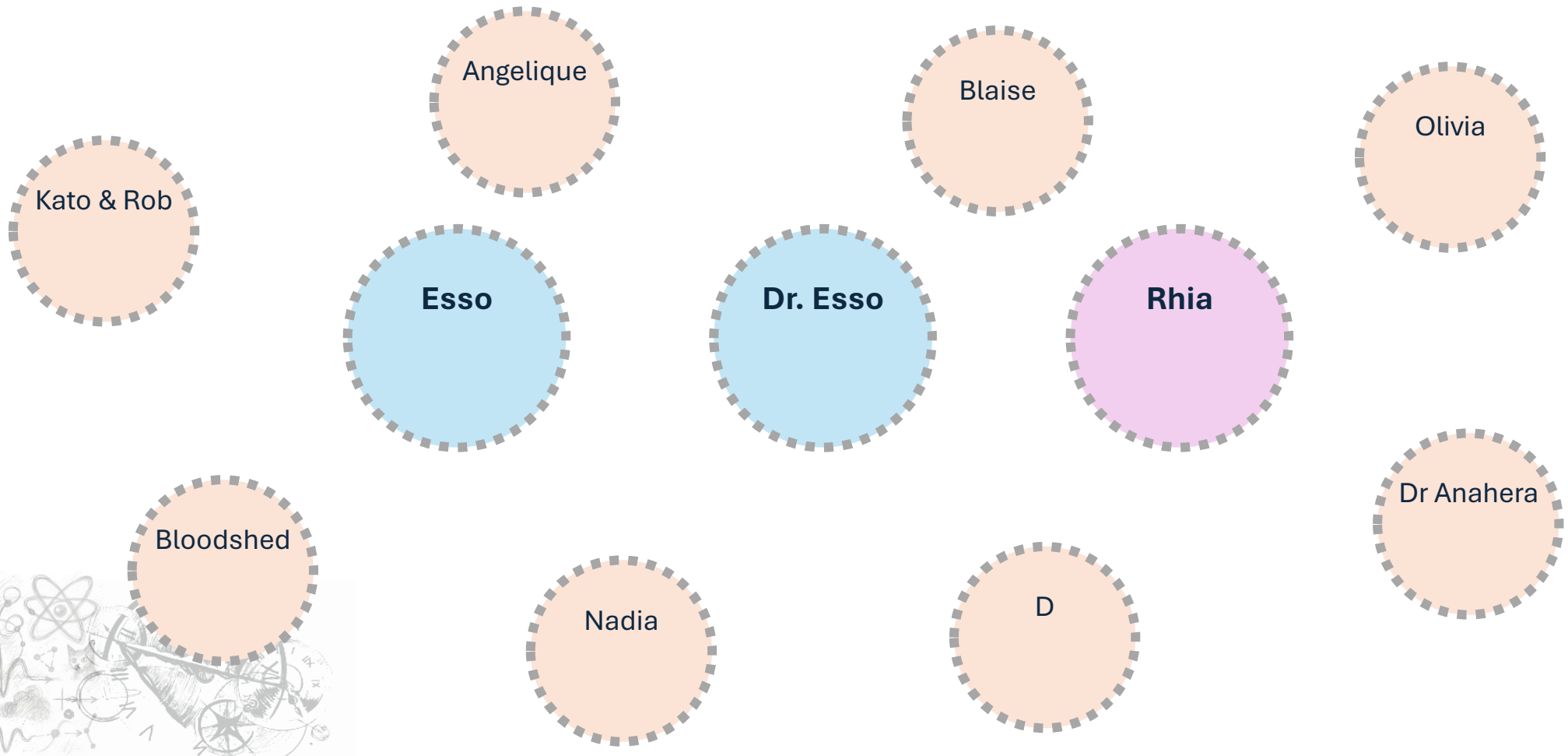
Theme	Notes
Identity	
Choice	
Environment	
Transformation	
Paradox	
Class	
Knowledge	
Deception	
Power	
Nihilism	
Faith	
Rebirth	
Purpose	





## Character Web: *The Upper World*

1. After reading the text, summarize Esso & Rhia's "character themes" in 1 word.
2. Then, summarize the character themes for the other characters in 1 word (add more circles if needed).
3. Finally, draw lines between characters and summarise these "relationship themes" in 1 word.





## Character Web: *The Mirror World*

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3. Finally, draw lines between characters and summarise these "relationship themes" in 1 word.

Esso

Imogen

Zedek

Olivia

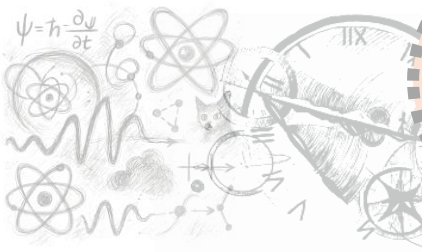
Rhia

Anna

Devontay

Prof  
Winthroppe

Justin



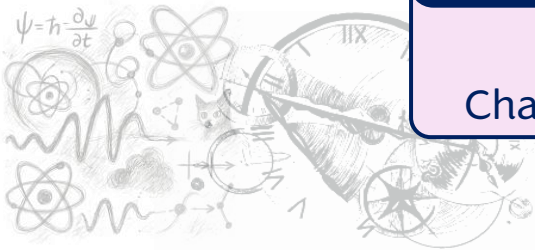
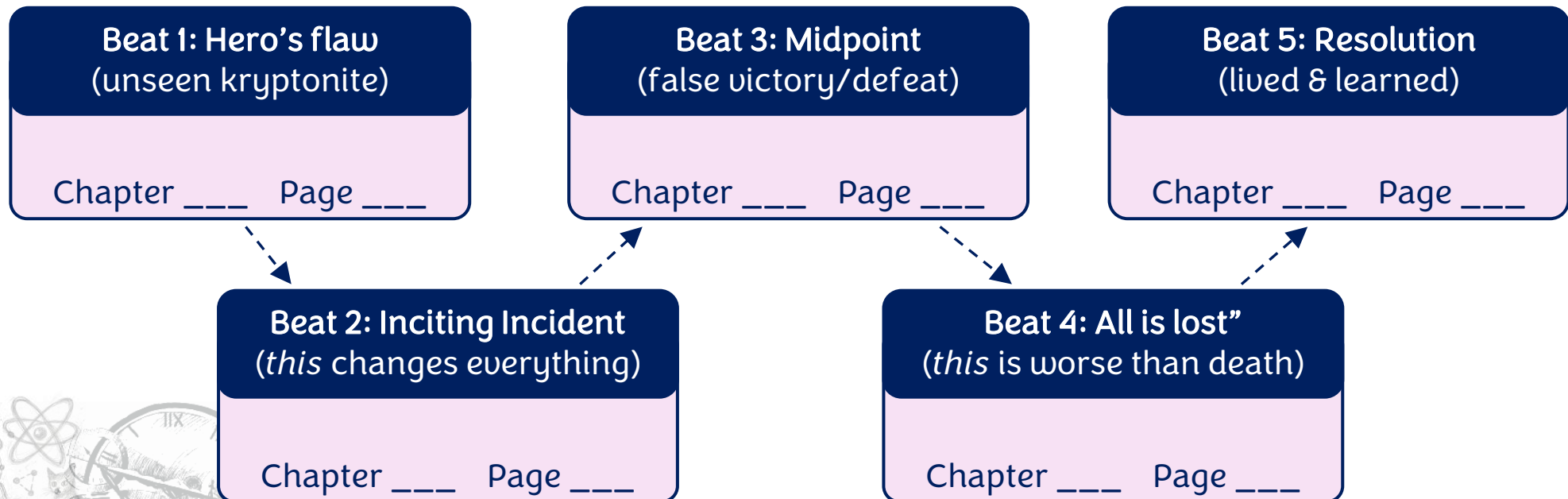


## Story Structure Challenge

1. Read the whole book first – no stopping.
2. Grab the beat sheet (below) and note where each beat happens.
3. Compare your beat sheet with classmates and agree on a final map!

### Stretch activity:

1. Replace the book's events with your own ideas (same beat sheet).
2. Pitch your beat sheet to your classmates and “crowd-source” a few “What if?” upgrades!



# @English Teachers



## Meta-Story Comparison (stretch exercise)

After reading both *The Upper World* and *The Mirror World*, compare & contrast them.  
(Consider: character arcs, themes, plot points / twists, settings, timelines, language, tone etc.)

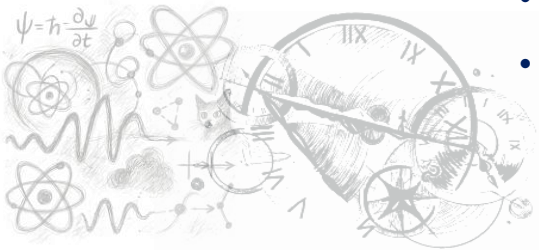
### Similarities

- 
- 
- 
- 
- 



### Differences

- 
- 
- 
- 
- 



# @Physics Teachers



Need lesson prep ideas for your next class?

Why not hook them in with a quick story!

1. Check if the table (see right) has a **physics concept** related to your lesson topic
2. First, read the excerpt to yourself and write down one **link word** (or sentence) that links the excerpt to your lesson topic (see box below)
3. Perform it **aloud** in class!  
(use the board, add drama, voices, have fun!)
4. Reveal your **link word** & to segue to your lesson  
(Bonus: let students guess your link word!)

*write link word here*

## Electricity, Magnetism, Electromagnetism & Light

Electricity & magnetism	Excerpt 1
-------------------------	-----------

Light & electromagnetism	Excerpt 2
--------------------------	-----------

## Relativity of motion, space and time

Relativity of motion	Excerpt 3
----------------------	-----------

Relativity of time	Excerpt 4
--------------------	-----------

4-dimensional spacetime	Excerpt 5
-------------------------	-----------

## Quantum Physics

Quantum superposition	Excerpt 6
-----------------------	-----------

Quantum entanglement	Excerpt 7
----------------------	-----------

## Forces & Fields

Electromagnetic field	Excerpt 8
-----------------------	-----------

Strong nuclear field	Excerpt 9
----------------------	-----------

Weak nuclear field	Excerpt 10
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‘Why don’t you tell me what you lot are learning in physics at the moment in school?’ he asked.

‘Ummm,’ I responded, thinking back to Mrs White’s class that morning. ‘Electricity and magnetism.

Safe,’ he said. ‘Let’s start with electricity, then.’

Who the hell said ‘safe’ any more?

For the next twenty minutes, he forced me to read out every line of maths I wrote down, before having me summarize *why* each equation mattered. As if they mattered! The worst part was that, whenever I gave a vague response, he’d force me to reword it into a sentence that a ‘ten-year-old chimpanzee’ could understand.

‘When you pass electricity through a wire,’ I dictated, ‘a magnetic field forms around the electricity.’

‘Safe,’ he said. ‘And . . . ?’

Given we’d gone through it minutes ago, it was taking me an embarrassingly long time to remember. I really did need this tutoring. The other crap part of switching schools mid-year (besides losing my old football team and all my mates) had been keeping up with a reordered curriculum and kids who brought in apples for their teachers. Full-on tree-fresh apples. Unbelievable.

‘And the reverse is true as well,’ I added, recalling the clip we’d watched in class that week on how power stations worked. ‘When you pass a magnet by a wire that’s coiled up the right way, you generate electricity in the wire.’

‘OK, so electricity generates magnetism and magnetism,’ he confirmed. Then, came of look of mischief that made me fear for what was coming next.

'OK, so electricity generates magnetism and magnetism generates electricity. What's the *speed* that one thing creates the other?'

'How the hell am I supposed to know?' I shot back.

'Rhia,' he said, a little sterner than I'd expected. 'You've got all the numbers you need in the back of your textbook, innit. So please go ahead and calculate the speed of this electromagnetic effect. It's the same speed in both directions, so I only need one answer.'

'Fine.' Into my phone's calculator went the figures I'd jotted down. Out came the answer: 'Two hundred and ninety –'2

'Just round it up.'

'Umm . . . so, around 300,000 kilometres per second.'

'Yes, blood,' he said, weirdly animated. 'Now go on and punch that number into the search engine on your phone.'

I did. None of the results had either electricity or magnetism in their titles. Instead they all featured the same word: *light*. It felt out of place, like asking for rice and peas and getting jollof instead.

'The Man is tellin me this is the speed *light* travels at.'

He sat back in his chair, grinning. 'Ain't that a coincidence?'

'I don't get it. Weren't we learning about magnets a second ago? What's all this light malarkey?'

It was an innocent question, but the grin that appeared on his face made me think, *Oh no, what have I done?* A minute-by-minute countdown to the end of class was already sounding in my head; my question was one more hurdle between me and the last train that would get me to the social on time. The maths that actually mattered to me unrolled in my head: if I wanted to get to the venue within ten minutes of the start time, train and bus wouldn't cut it any more. Getting a Zuber was my only remaining option. But my debit card had precisely 18p on it, meaning I'd have to hope that a) the driver was cool with doing a cash deal off-app, and b) the coins I had in my pocket could carry me at least halfway.

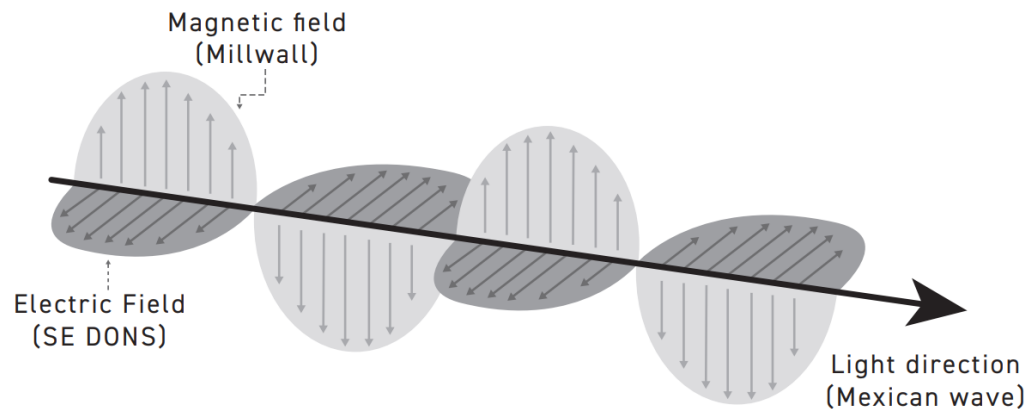
'At the most basic level,' he continued. 'Physics is a simple dance between storytelling and equation-writing. It's just metaphors plus maths.'

He pulled a silver gadget the shape of a Coke can out of his bag, then placed it on the desk. I'd seen adverts for it on the Tube: a Caster-5. It looked clunkier in the flesh. 'We've patterned all the maths already.' He pressed a glowing button on the side of the device. 'So now we've just gotta come up with the right metaphor: a good *story* to help us see it and make sense of it.'

'Sure,' I responded at bullet speed, hoping he'd get the hint and talk faster as well. It was ten minutes to eight. Max five minutes before I had to head out.

'Imagine Millwall is playing SE Dons right here at Dangote Stadium,' he said. The device shot up a blue cone of light that, after a few seconds, condensed into a 3D projection of the stadium we were sitting in. 'Now picture the two sets of fans sitting in small alternating blocks round the stands. There's only a few minutes of the match left and it's been a dry one, so one bored Dons fan starts a Mexican wave.' The projection morphed as he described the scene, providing matching visuals with zero lag. 'If my Caster-5 is doing its job right, you should be seeing a group of dark-skinned yutes springing up and sitting down; then, as the wave hits the next section, a bunch of white Millwall fans doing the same. And it just keeps going round and round the stands in perfect zebra harmony.

'It turns out,' he continued, 'that's what an electromagnetic wave looks like.' He leaned closer to the device. 'What light looks like.



A final hologram appeared – a diagram.

'Light is just a series of electrical and magnetic waves, each ripple creating the next ripple, then the next, and moving the whole beam of light forward in the process.'

'Just fascinating,' I responded flatly. To be fair, his comparison wasn't that awful, and neither were his gadget's pyrotechnics. Any other night, I'd have even complimented him. But not with two minutes left before I had to dust or potentially face lifelong consequences.

My homework was open and, as usual, he made me read it out loud. 'No matter how slow or fast you're going,' I said, 'light will always be going 300,000 kilometres per second faster than you. No matter what. **PLEASE DISCUSS!**'

I'd actually spent a decent amount of time on it the night before, but, after an hour of staring at the sheet, I still hadn't come close to a satisfying answer. I also knew there was much less chance of Dr Esso raising one of his scraggly eyebrows if I showed interest in his mid-lesson monologues. It worked in my favour to have him believe I gave half a shit. Showing any sort of curiosity about an adult's interests was the easiest way to have them eating from your palm.

'And?' He leaned in for my response.

'And it doesn't make any sense.'

'Don't it?' he asked.

'I literally spent all night wondering why you'd put me through this torture.'

He chuckled to himself. 'I know it sounds crazy, but it's important you proper get this one.' He started tapping his foot. 'That way, you'll understand everything else I need to tell you.'

I felt my chest tighten, my neck getting so tense that I couldn't move it. *Mum*, I thought, wondering if that was where he was leading me. Maybe Dr Esso had found me on purpose. Maybe she was why he was here.

No. I had to focus. I couldn't afford to hold those hopes too long or let one shady comment dismantle the trap I'd planned.

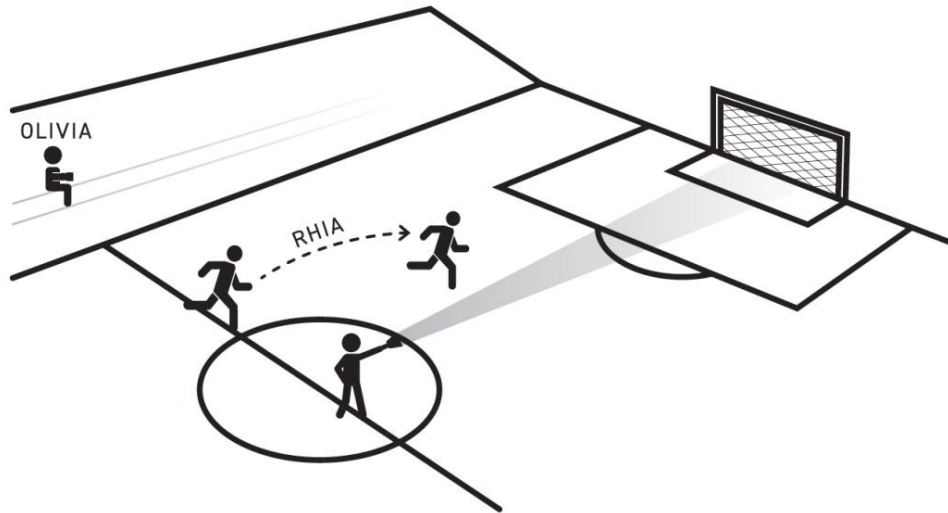
After some time rummaging, he placed his Caster-5 on the table, smiling like a rich kid on Christmas. I still couldn't understand why he was so fanatical about this physics stuff, but I knew I had to *pree* everything he said, regardless of the topic.

'OK.' I took a quiet breath in, reminding myself to use the same kind of words he liked using. 'So, I actually came up with my own "thought experiment". Just to prove how ridiculous the statement in your assignment is.'

'Let's go,' he said with the same overexcitement he'd had from the start.

'All right – so, imagine it's just me, you and my sister, Olivia, in Dangote stadium. Olivia's sitting up in the stands, while you and I are down at the halfway mark on the pitch. You've got a torch in your hand and decide to turn it on and point it at goal. And, for some reason, I decide to chase after the light beam that comes out of it.'

A hologram appeared above the table, a near-perfect rendering of the scene I'd been imagining.



Safe,' he added. 'I'm following.'

If he says the word 'safe' one more time, I'm going to shoot myself in the face, I thought, but out loud, continued: 'Now, imagine Olivia has this device that can measure the speed of the light coming out your torch. There's no reason she wouldn't get the bog-standard speed for light when she measures it, right?'

'Right. So around 300,000 kilometres per second.'

'Exactly,' I confirmed. 'All right, bom. Now let's say I'm carrying my own light-speed-measuring device as well. And, I know it's stupidly far-fetched, but let's just say that by some miracle, maybe with a jetpack or something, I'm able to reach a super-fast speed while I'm running after the light beam . . . as in, almost light-speed fast, so, like, 298,000 kilometres per second, instead of around 300,000.'

'I'm digging it still,' he confirmed. 'Keep going

'Well, this is where it all goes pear-shaped: if I'm running fast enough to almost catch up with the light beam, I should measure the light beam as only going a tiny bit faster than me, right? Like 2,000 kilometres per hour faster?

'Don't get me wrong,' he replied. 'Your logic makes sense for pretty much everything in the universe. Except light. Here, your gadget would say that the light beam is still going 300,000 kilometres faster than you. And it would be right.'

He smirked. I should have been happy as well; I was executing my plan perfectly, convincing him physics was all I had on my mind. But I still felt like chucking my textbook at him.

'So, let me get this straight,' I demanded. 'On one hand, Olivia is sitting completely still, and she measures the light beam as going 300,000 kilometres per second faster than her towards the net. On the other hand, I'm running at a whopping 298,000 kilometres per second, and my device says the same thing? That the light beam is going 300,000 kilometres faster than me as well?'

'Correct.'

'But that makes no bloody sense!'

'Like chasing after a sunset, innit,' he added, grinning. 'Or like tryna fill up a bucket with a hole in it. And the faster you dump water in it, the faster it leaks out.' He stopped himself from coming up with a third comparison when he realized I wasn't laughing.

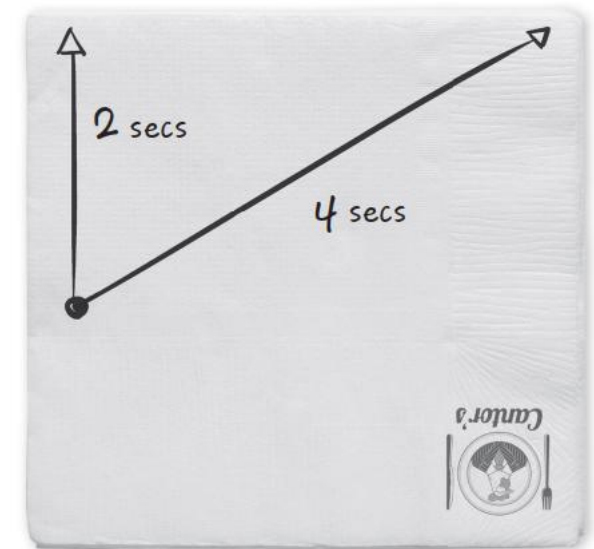
'All right. Time travel. Maths. Explain. Now.'

'You asked for it.' I took a fresh napkin from Olivia, pausing for just a few seconds to think through my explanation. Then I clicked my gel pen. 'Imagine the ink in here is a source of light. So any line I draw on this napkin represents the path a beam of light can take.'

I asked her to pull up the stopwatch on her phone. 'I want you to press "start" on that once I start drawing. Then press "stop" when I reach the top. Cool?'

After I'd finished drawing, she read out the time stamp. 'Around four seconds.'

'Nice one. Now I'm gonna draw a second line, starting from the same place as before, but this time I'm making the light travel vertically up, rather than diagonally like the last one.'



'Two seconds,' she said the second time, watching me scribble her numbers on the napkin.

'As you can see, it took me twice as long to draw the diagonal light beam as it did the vertical one. Why?'

'Cos it's twice as long, innit?' She looked unimpressed so far.

'The light had twice as far to go.'

'Yes! And because I kept my writing speed – i.e. the speed of light – the same both times.'

She opened her mouth to speak, but, before she could get any cheek out, I reminded her, 'You're the one who asked me to explain this to you. Gonna let me land or not?'

'Chill, fam – I was actually just thinking,' she replied, leaning forward again. 'Jesus.'

'This final bit will only take a minute anyway.' I stole the last remaining napkin from her lap. 'All right, boom. Now I need you to imagine Tony driving his old Tesla out at night with Poppy in the passenger seat.'

'So all I have to do is imagine a world where Tony has his licence back,' she said, giggling. 'And hasn't chugged half a bottle of Famous Grouse before getting into a car.'

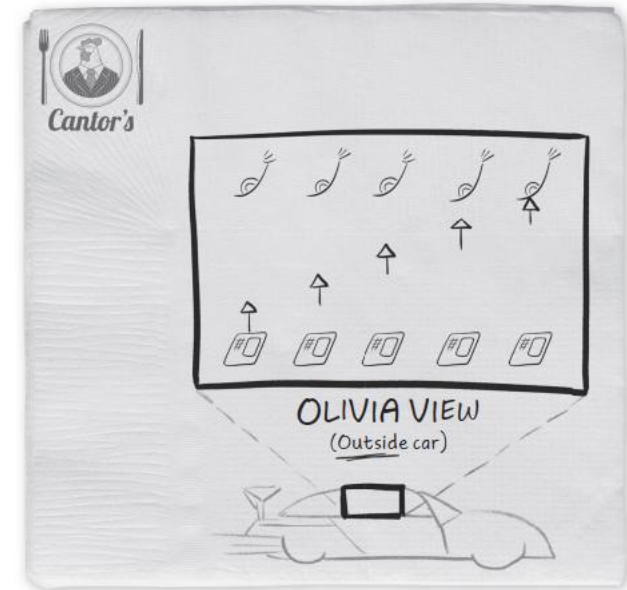
It crossed my mind that maybe Tony liked a drink because he was into time travel as well. A half bottle of spirit let Tony take all of today's problems and dump them into tomorrow. And, with just a few more swigs, he could steal all of tomorrow's energy and squander it today.

Even if you never quite knew when he was, at least he was there. He and Poppy were the only ones who gave enough of a shit about kids like Olivia and me to put us up. Tony was also the one who'd pulled strings with Gibbsy – his old mate from when they were at secondary school together in Devon – and got me my trial at Dons. So we had Tony to thank for the heated seats we were sitting on and, assuming I kept impressing the head coach, for my soon- to- be- full- time contract.

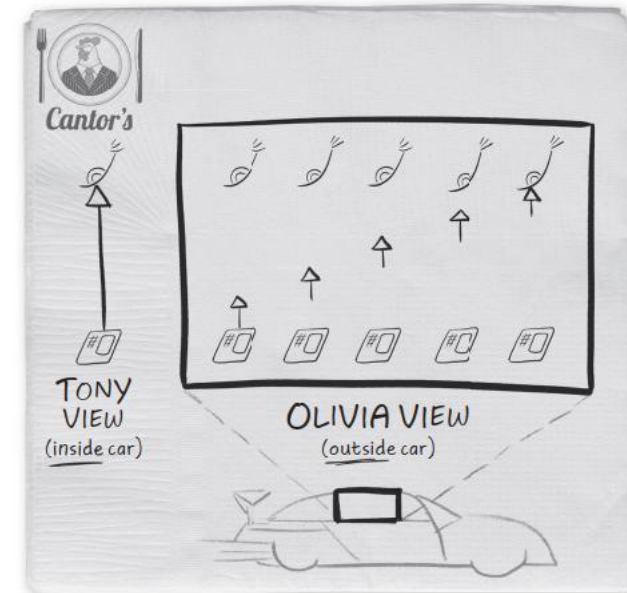
## Appendix: Excerpt 4 (cont'd)

'Anywaysss,' I hissed, trying to remember where she'd interrupted.

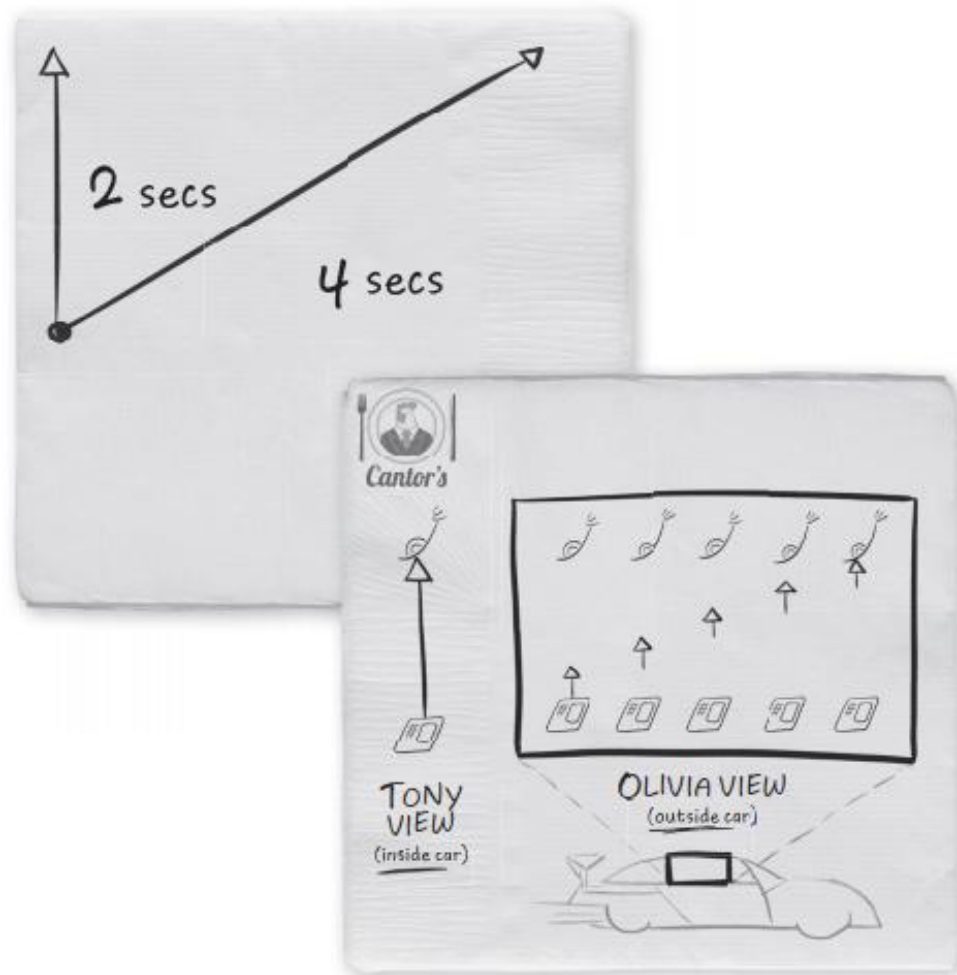
'So, yeah – Tony's speeding along. Poppy's in the passenger seat, and, by mistake, triggers the torch on her phone, making its bright white light shoot straight up into her eye. Now imagine you –' I lifted my pen at her – 'are standing on the pavement when the Tesla goes by. Since the car is speeding past you from left to right at the same time that the light from Poppy's torch is shooting vertically up into her eye inside the car, you basically see the light beam taking an overall diagonal path. Sort of like this.



'Now, if you're looking at the same event from Tony's perspective – i.e. watching this scene play out from inside the whip – the picture's quite different. Since everything inside the car is moving at the same speed as the car itself, the phone in Poppy's lap looks stationary to Tony. To him, the phone isn't moving backwards or forwards – it's resting in the same spot in Poppy's lap next to him the whole time. So, when Tony turns to the side, he just sees the light beam shoot straight up into his wife's eyes – he sees it travel vertically.' I sketched the final bit of the diagram for her.



## Appendix: Excerpt 4 (cont'd)



'You see where this is going?'

She stayed quiet. The guy next to her shook his head for the umpteenth time, probably wondering why our analysis couldn't wait till after the match.

'Lemme summarize. You and Tony both saw the exact same event: a light beam going from Poppy's phone into her eyes. But the path

you watched the light take was diagonal – and therefore twice as long as the vertical path that Tony saw from his seat.'

I overlaid the second napkin on the first so she might catch the resemblance. 'So, if Tony claimed that the light took two seconds to get to her eyes, then you would say it took –

She put her hand up, so she could answer. 'I would say it took four seconds. Twice the time.'

'Yes, Olivia!' I held out my right fist, but she was too busy nappingazing to notice. 'So, the time it takes the light beam to go from the phone to her

eyes is different, depending on who you ask ...' A corner kick later and she still looked spooked by her own answer. 'Shiiiiit.'

'I know,' I replied, glad to see she was having the same reaction I'd had when I'd realized it.

'But who's right?' She was still absorbed in the diagram. 'Did the light beam take two seconds to reach Poppy's eyes? Or four seconds?'

'That's the manic bit: you're both right!' I grabbed her shoulders, turning her to face me. 'We grow up assuming there's some invisible silent grandfather clock out there that sets the time that the universe marches to.' I could feel my pulse rising, but I forced most of my excitement into hiding. 'But that's all completely wrong. We actually all have our own clocks: some ticking at one pace over here, others ticking slower over there. And turns out, the faster you move, the slower your clock ticks compared to everyone else's.' I pointed back to the napkin. 'So, because Tony was in a speeding car, he saw the same event take half as much time as you did.' I paused to let the next line really bang. 'Fewer seconds passed in that car, which means time literally went slower for him and Poppy.'

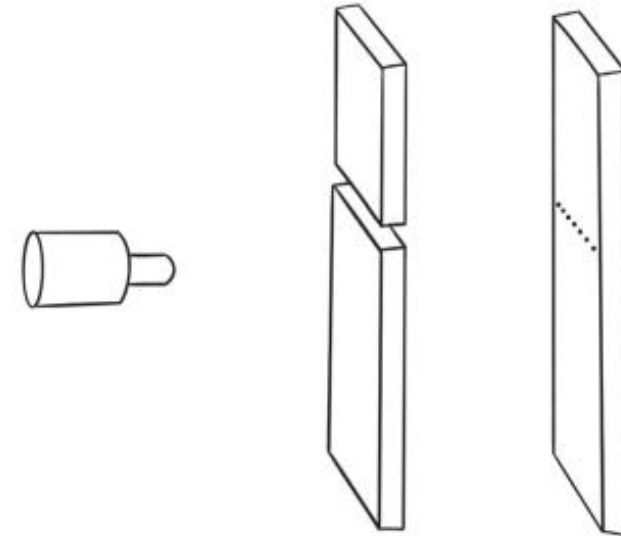
'When time stretches out like that,' I continued, 'it's called time dilation. It happens all the time in real life, and the effect is just too tiny for us to notice. But, if you got near the speed of light, you'd notice it. You'd see time slow down to a fucking trickle.'

'You've changed, Rhia,' she said, only half joking.

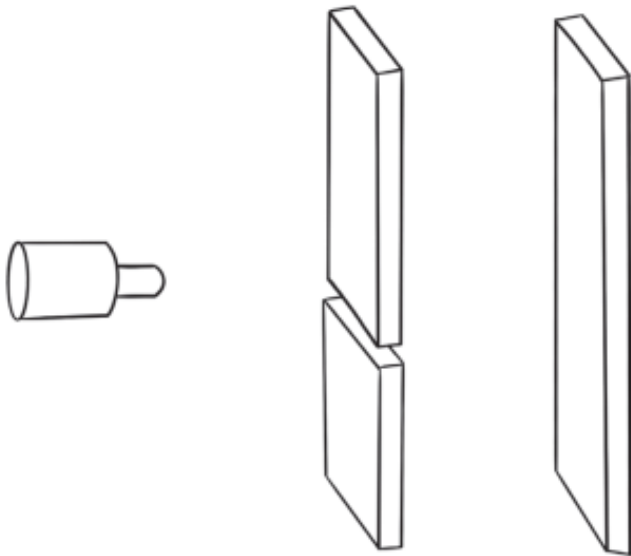
What Dr Esso had told me – about reality existing in four dimensions – had somehow made sense. I thought back to just before our first tutorial. I'd sent him my location, a pin that showed where I was in terms of longitude and latitude on the map: the first two dimensions. Then I'd told him we'd be working in the kit room on the top floor, so he'd know where along the third dimension – height – we were headed to. Finally we'd agreed to meet at a specific point in time: the fourth dimension, which, ironically, he'd ignored and arrived when he'd liked. Since I could use those same four dimensions to locate every event in my life, it wasn't too far-fetched to believe we might live in this 4-dimensional space–time thing he wanted to cross. What had actually blown my mind was the trail of breadcrumbs he'd used to guide me to that conclusion.

‘Pick up that green marker on the desk,’ he ordered, wiping off the lines of equations from his last lesson. ‘On the left side of this diagram is a laser that shoots out light, one photon at a time, towards the screen on the far right,’ he explained. ‘But that barrier in the middle blocks all the photons except the few that pass through the slit. Now, each time one of the photons gets through and hits the screen, it leaves a mark on it.’ He stepped further back from the board and waited for me to take in his sketch. ‘So, tell me, after a minute or so of that laser shooting photons one after the next, what sort of mark pattern would we expect on the screen?’

He pulled a handkerchief from his trousers and, after emptying his nose, folded it in four and lodged it away again. For the life of me, I’d never understood handkerchiefs, and how people fooled themselves into thinking an origami trick made storing a day’s worth of bogies on a thin sheet of cloth any less nasty. I shuddered. Then I pushed the thought to the back of my mind as I walked up to the whiteboard and drew out the logical answer.

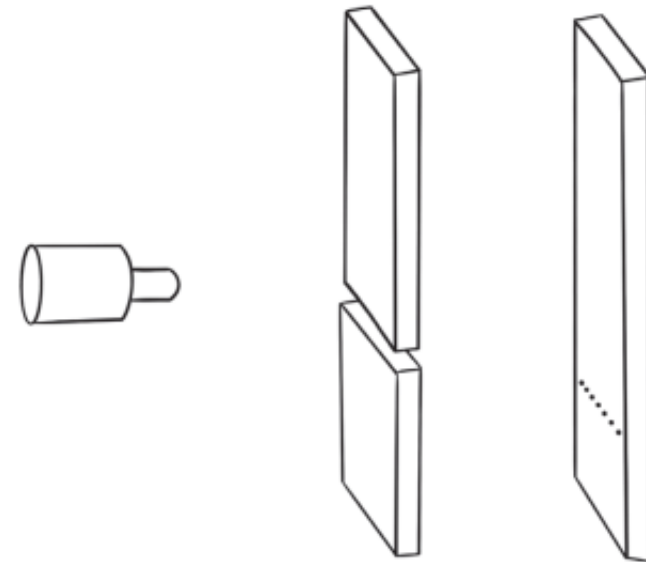


'That's adequate,' he said, the board wiper back in his hand. When he'd finished redrawing the diagram, I noticed he'd drawn the open slit nearer the bottom instead of the top this time.

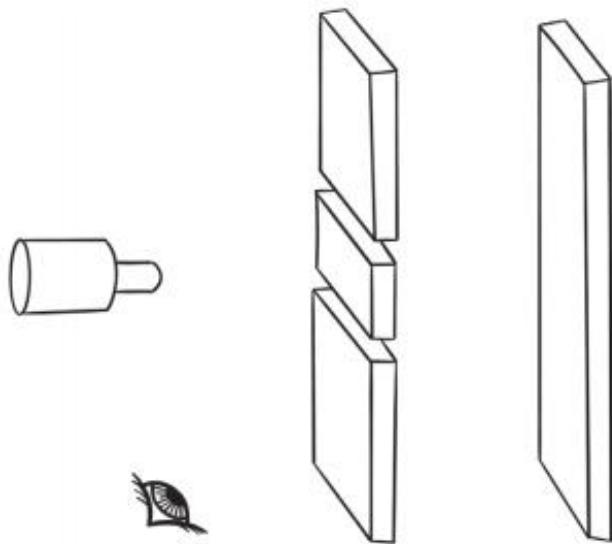


'And now?'

I sketched my updated response, hiding my smile as I drew.

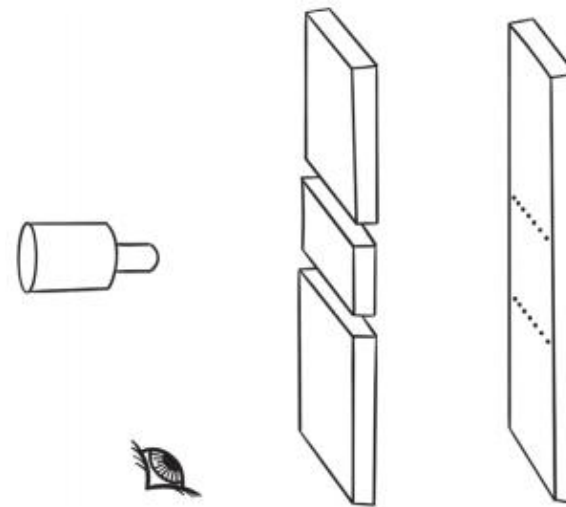


'Fair play.' He redrew it so both the top and bottom slits were open. 'Well, how about now? But hold on.' He put his hand up just before I could step forward again. 'This time, let's say we install a camera inside the box, so we can also watch the electrons as they fly across.'



He pointed to the makeshift eyeball, and I nodded back so he'd know I'd registered it before attempting my answer.

I paused. *But why should placing a camera make any difference?* I thought. Then I realized this was probably like one of those Bac exam questions where what they're testing is your ability to ignore unimportant details. Plus, given how simple this question was, standing here looking gormless any longer wasn't exactly gonna upgrade that first impression. 'This is what you'd get.' I stepped back and waited for his review.



'Bravo.' He clapped. Coming from a Nobel Laureate, it was maybe the biggest compliment I'd ever received in my life. Was this warmth in my face how white people felt when they blushed? Before I could bask in it much longer, he'd rubbed out the eyeball. 'And, last of all, if we simply removed the camera we'd installed, and isolated the experiment from outside interference again, what pattern would we get on the screen on the right?'

'Well, you'd obviously get the same result,' I replied, with a shrug. But he didn't say a word. Instead, he just looked more intensely at me, as if he was giving me a chance to reconsider. And so I did. But my mind was unchanged. As I waited for him to confirm, I started wondering if someone had turned up the central heating since the last question.

'I'm afraid that's incorrect.' The words hit like a sledgehammer to my sternum.

'Umm ...' I smiled through gritted teeth. 'What exactly do you mean by incorrect?'

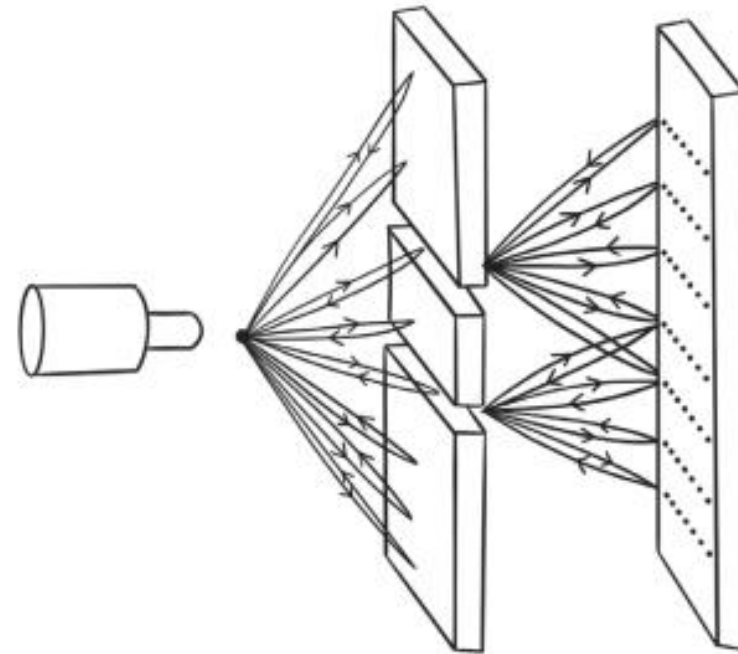
'Allow me to explain.' Seeing as I was too stunned to move, he pulled the marker out of my fist and started sketching, and before he'd got halfway I could already see what was now on the board in front of me: a loophole. Or, more bluntly, the giant fucking crater that the discovery of quantum physics left in the laws of physics.

See, whereas Einstein's theory of relativity dealt with big and generally acceptable things like time and space and energy and gravity, quantum physics was all about what happened to reality at the unseeable scale of atoms. And the quantum realm, it turned out, just so happened to be a place where loopholes ruled supreme; and where outliers and quirks became the law.

Quantum physics had been the death of Einstein's famous career. And now, just as I was getting started, it was the death of mine.

'You see, in the quantum world,' Professor Winthrop began, 'if something's left unobserved, it doesn't exist just as one thing, but as a tangled mess of possibilities. And the way we know this is true without directly looking –' he'd finished rubbing out my mistakes and was tidying up his own dots now – 'is because each of those possibilities interacts with one another. In other words, even when we fire only a single photon across, the mere possibility of it going through the top slit fights against the possibility of it going through the bottom slit, which means that when the actual photon lands on the screen, it's in a spot that seems impossible.' He stood away from the whiteboard. 'Ergo, those impossible marks in the middle of the screen on the right.'

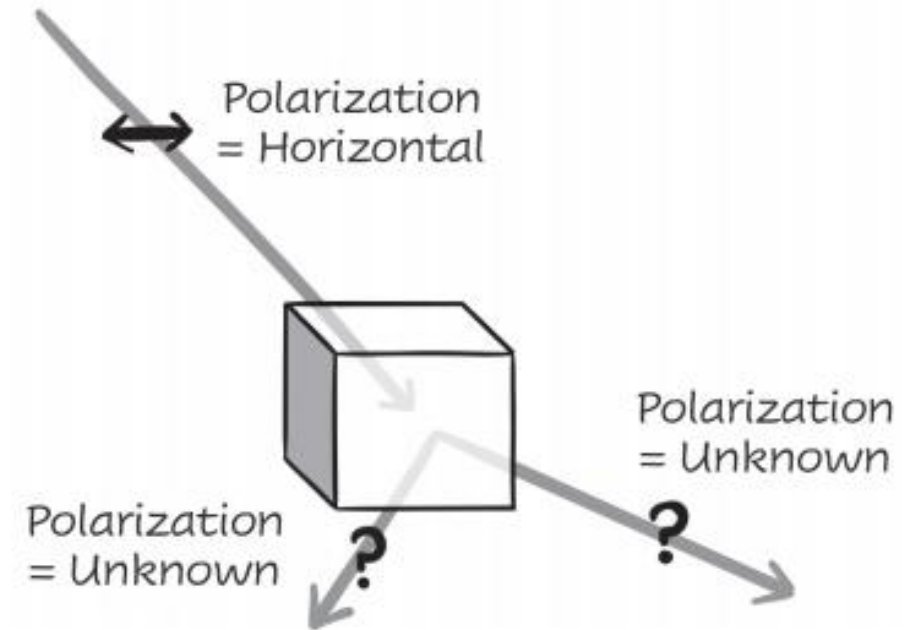
'Quantum superposition,' I remembered out loud, earning an unimpressed nod.



Winthrope took a break from scribbling. 'You mentioned something in your definition of entanglement I wanted to prod on. You said two separate things can be connected through their identities. Would you be so kind as to provide an example to illustrate that?'

Taking the spare pen, I got up to face the board. I knew the drill by this point and had my example prepared well before the lecture. 'Well, let's say we send out a single light particle, which is horizontally polarized.' The picture I always held in my mind for polarization was a Frisbee flying through the air. It could lie perfectly flat, in which case it was horizontally polarized, or vertically or even diagonally if it was tilted over on one side. 'Then, let's pass it through a special crystal that splits it into two fainter, entangled light particles. Sort of like this.' I stepped back from my drawing.

'Entangled, is it?' He liked to repeat what I'd said when he wasn't yet convinced. The fact he'd taken a break from puffing on his pipe was another clue.



‘Well, when the light was just a single particle, we knew it was horizontally polarized. We knew its identity. But after passing it through the splitting crystal we end up with two new particles that could be polarized in any direction whatsoever, and we won’t know which till we measure them.’

‘I’m still not understanding where the phenomenon of quantum entanglement specifically comes into this.’ He did. What he was really asking was: did I?

‘Well, this is where the loopholes of quantum physics come in. It turns out I only need to measure one of the two light particles and – bam! – once I know that first photon’s identity, I instantly know the second one’s identity too. It’s like some invisible thread snapped into place the second they left the crystal, binding them tighter than twins. Suddenly, these two particles, once perfectly separate, somehow become . . . inseparable: connected, entangled. From then on, peering into the soul of one is just as good as peering into the soul of the other. And whatever happens to one, instantly affects the other – no matter how far apart they are.’ As weird as the words coming out of my mouth sounded, I’d seen the experiments. Just last month, some scientists in China had successfully entangled a particle in Shanghai with another on the North Pole of Mars. And after opening the box on Earth containing the first particle, and declaring its state, they were able to call the astronauts on Mars and tell them what their particle’s identity was before they’d even opened their Martian box.

I waited for a nod, but instead got his usual folded-arm stare.

‘That’s adequate.’ He turned his back on me and started adding Greek scribbles to where he’d left off in his equations. ‘As you said, there’s something connecting them that exists almost beyond space and time. And it allows an instantaneous transfer of information and identity. Even faster than the speed of light.’

Thunder rumbled above as the Man finished his descent, barely a sound from the gravel as his feet touched down.

I stepped back. Not only was this my first time seeing a man float from the sky but this particular man was already the most powerful person in the country. 'The electromagnetic field,' I muttered under my breath, biting down so hard I heard my cavity creaking. It was the first physics principle Esso had taught me all those years back.

Esso had always said he doubted that the rickety village his parents came from was the only place in the world where people knew about the hidden powers of the Upper World. And, for the hundredth time this week, I hated to admit that he'd been right. But after I'd taken the time to look back on things yesterday, and for the first time with honest eyes, I'd seen that the signs had always been there.

Like when I'd first seen the Man talk at the Union that night with Olivia. Every time he'd been asked a question he didn't like, the lights had seemed to flicker. There was also the inhumanly violent shock that had run through my arm the first time we'd shaken hands. Then there were the birds. A while ago, some PhD student in Oxford's Quantum Information Processing department named Eric Gauger had discovered that when there was no sunlight certain species of birds used the quantum properties of electromagnetic fields to navigate the skies. And whenever the Man was around and charged up, it was as if all the birds lost their bloody minds.

'Why did you kill her?' I demanded.

With a snap of his finger, sparks flew out from the security cameras attached to the high corners of the building behind us. Then, one by one, the fairy lights dimmed to black too.

*Shit.* I forced my expression to stay neutral, fighting to keep the dread from ballooning inside me, all while the full weight of it sank in: my plan to catch him on video had just gone dark along with the CCTV feed. It didn't help that I'd left my phone and XR lenses behind too, not wanting to risk having any electric conductors attached to my body while he was this close. I needed to buy time, so I could prepare for plan B: fighting him.

'She told me everything. How you've been—'

He put his hands to his lips as he walked round me, carving a wide circle with me alone at the centre.

I slyly reached behind my back to make sure the knife was still there and, while doing it, could have *sworn* that out the corner of my eye I'd just seen something levitating. A quick glance later confirmed that not only was a steak knife from a nearby table floating in the air but it was pointed at me too. The magnetic component of the electromagnetic field was what he must have been using to lift the metal blade. And the electricity was why its sharp edge was sparkling. A sudden movement from me could jolt him into launching it straight into my chest. So I trained my eyes on him, cooled my breath to think. *Think hard.*

Meanwhile, he continued striding, the radius of the circle decreasing as more steak knives ascended into the air. He wasn't meant to be this skilled. This in control. And also, why were so many bloody people still eating beef in 2045?

Realizing I had mere seconds till the closest knife was in touching distance, I began filling my mind with equations, the precise coefficients and geodesic trajectories I'd studied in my old room last night before training with Esso. In order to control something, you have to understand it. To understand something, you have to be able to explain it: you need words. And mathematics was the written and spoken language of the Upper World, the place that bridged and the power of the mind to the power of the field. And my field was gravity.

To Esso,

*I believe, like our ancestors did, that the earth never hides the things we need, but instead provides them in abundance. Light Energy rains on us from the sun; Chemical Energy is digested from the harvest; Electrical Energy strikes in lightning. But Hidden Energy? Mother Earth concealed that from our eyes for millennia.*

*Then a new generation came along. Products of the Steel Age, you could call them. And one among them, Einstein, had the most original of ideas, followed by the most dangerous of afterthoughts.*

*Einstein took a well-known fact – that light travels at a constant speed for all observers – and went on to reveal that space and time were fluid. Exactly three months later he published a speculative article that ended with  $E = mc^2$ .*

*I must emphasize just how abnormal this journey of discovery was. Imagine finding a loose string in your rug and pulling on it. As you pull, the thread arrives in a rainbow of brilliant colours, none of which you've ever seen on the surface. You keep pulling and pulling until your entire carpet has unwound and you finally realize the thread is tied to something underneath your floorboards. And, when you lift the plank to see what you've been tugging on, you discover that, buried under your living room, is a bomb.*

*That's what Einstein's equation said: hidden inside even the tiniest bits of matter is an ungodly amount of destructive power ready to be unleashed. I'll admit, I didn't think much about Hidden Energy when the Elders explained this all to me. Not until a few years ago, when my fellowship paid for a trip to Hiroshima – the city where Hidden Energy was first revealed to the world.*

*We had been taught about the first atomic bomb the world dropped on the Japanese in World War II. Our teacher told us it killed around 146,000 people. But she left out one small detail: most of them were kids. They leave out those child-sized details in the textbooks as well. Like the burns. I had heard of first-, second and third-degree burns before. But visiting Hiroshima was the first time I learnt there is such a thing as fifth-degree burns. That's when your flesh turns straight into charcoal. They don't show you the photos of the rain that fell that evening – each drop sticky and soot-black. The kids were so charred and thirsty that they opened their mouths to the heavens, drinking in as much of the radiation-soaked water as they could. Many died from it. The ones who survived suffered from diarrhoea for months. Then they died too.*

*My child, I have read about Japan's cruelty towards its enemies during war. Believe me. I have heard people say that, by dropping the bomb, we ended the war early, that countless lives were saved. But none of it seems to wash that bitter taste of Black Rain from my mouth.*

*146,000 people.*

***146,000** people.*

*146,000 **people.***

*If you sat the bodies of those kids in double-decker buses and, starting from Peckham, lined up the buses end to end, you'd get to Piccadilly Circus and back. And it took less than a kilo of nuclear material to erase all those souls. Less than a kilogram. The approximate weight of a human heart.*

$$E = mc^2$$

*Look at it, how bland and tiny it looks. Three letters followed by a tiny number that even a toddler can count to. You have to look closer to understand how it creates its terror. Written in words, the equation simply says:*

***Energy = mass × the speed of light (squared)***

*So, for 1 kilogram of explosives, that's:*

$$\text{Energy} = 1 \text{ kg} \times (300,000,000 \text{ m/s})^2$$

*Which, when you multiply it out, gives:*

$$\text{Energy} = 90,000,000,000,000,000$$

*That final number is ninety quadrillion. Or, put another way, 90 million billion units of energy. Staring at the maths, you realize – it's the speed of light, that *c* in the equation, that fucks you. That's what killed those kids. 300,000,000 is already a devilishly large number; then the equation takes liberties and forces you to square it. They never stood a chance.*

*My colleagues tell me I have a habit of mixing my science with my superstition. But I believe all of us can feel Hidden Energy around us, flowing past us, through us. When someone you love walks into a room, and you feel that surge, that tug on the fabric of space–time between you. I tell you all of this because, if I could have spoken to my younger self, I would have warned him. I would have asked him to find a less destructive way. Old Eve might have been the wise one all along. She knew some things were better left forgotten.*

I thanked the boy for bringing in the books and decided to walk him down to the exit on the ground floor. As we passed the shelves, he suddenly stopped, his eyes locking on to a blue textbook. Without a word, he did a full U-turn, as if the title had pulled him in by its own gravity.

‘The *weak* field?’ he asked, his hands tracing the silver-printed letters. ‘What’s that?’

I picked it up and handed it to him ‘Well, in physics, there are four invisible fields, almost like hidden oceans, that fill the entire universe. Gravity pulls everything down to Earth. Electromagnetism handles electricity, magnetism and the light you see. The strong field keeps the core of atoms together. And then, there’s the weak field, the one that transforms one thing into another.’

‘Why’s it called the “*weak* field”, though?’

‘Well, because it’s not as strong as the others in terms of its direct punch. But here’s the thing.’ I leaned closer, almost dropping to a whisper. ‘It’s the weak field that fuels the energy from the sun. Without it, there’s no day, no life – nothing. It’s the field responsible for me and you being here, having this conversation. So, while it’s called the weakest, it’s actually the one that makes everything possible. And understanding it . . . well, that’s like holding the key to life itself. Can you imagine having that in your hands?’

No one has ever seen where the Upper World starts and ends, assuming it ends at all. The only thing scarier than the thought of you going up there alone, is the tragedy of you not knowing it exists. And so the little I know, my child, I will tell you.

**Firstly, you have to speak it to see it.**

Language influences what we see. In Greek, for instance, there is no such word as 'blue'. Either something is *ghalazio* (a lighter shade of blue) or *ble* (a darker shade of blue). Any Greek settling on this cloudy island will swiftly find their colour vocabulary cut in half; two vibrant colours tucked into a single English word, 'blue'.

But, as one curious study showed, Greeks who abandon their mother tongue also stop being able to *distinguish* between *ghalazio* and *ble*-coloured objects. They literally see half of what they used to – because of language.

Just like the shades of blue, time itself is relative. It passes at one pace here and a slower pace over there, all depending on where you are and what you understand. And, since time, light and everything else in the universe can only be properly described through the language of the gods, even a few lessons of childhood maths can provide a brief glimpse of the Upper World. But, until you are fluent in the sacred language, do not expect to see much more.

**Lastly, you must look through your WINDOW.**

Our brothers and sisters in the East say that each snap of your finger contains 65 unique moments. Using pen and paper, physicists today can prove that the number is even greater. Now imagine the vast multiplicity of moments contained in one breath. One smile. One dream. How does the mind continually hold the near-infinite granules spanning an entire *lifetime*?

It can't.

To ensure our survival, Nature decided long ago to restrict our view of time to a single moment: a solitary and ever-changing canvas on to which the immediate concerns of shelter, sustenance and procreation could be projected. The Now. Our view of the past was therefore relegated to a fuzzy blur and the existential distractions of the future blacked out completely. And yet our ability to tap into chronesthesia (mental time travel) was not destroyed. Only unplugged. Locked inside a crevice of our minds called the WINDOW.

The WINDOW is a memory from the past or the future. A memory unique to each individual, often so severe or traumatic that our minds force us to forget it. Due to the WINDOW being the lens through which we perceive true time, it is common to hear people claim that time 'slowed down' or even 'completely stopped' in these buried memories. It has been suggested that an acute or repeated concussion can temporarily 'yank' open one's WINDOW. But all we know for sure is that the only safe path to the Upper World is through an Elder guiding you to your WINDOW, once you possess the language to see what's on the other side.

In a few months you will leave your world and be born into ours, my child. You will be told that what you see with your physical eyes is final, and that men like me who claim otherwise are fools. But know that just beyond the tug of our chains and the warmth of this cave, a clearer, more terrifying world awaits us.