

TIME

Facilitator's runsheet for a 1.75-hour workshop for high school students

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Materials required for this workshop:

- Facilitator's copy of this runsheet
- 'Time' slideshow
- Video clip: Ötzi the Ice Man inquiry stimulus (7 minute clip)
- *Optional:* Audio clip: Ötzi the Iceman finally speaks (4 second clip)
- Three printed header cards ('Linear', 'Cyclical', 'Block'); and 14 slips of paper or card, each containing a single statement about time. These headers and slips may be printed from the accompanying PDF entitled 'Printable headers and cards for Time (3 circles) activity', and then guillotined in advance of the workshop
- *Optional:* Three large paper circles or hoops to more clearly establish categories for the 3 circles activity

[Time from start: 0:00]

Slide 1: [Cover slide]

Welcome and introductions.

Slide 2: [photo of the Alps]

We're going to listen to a true story adapted from the podcast *Radiolab*. This clip is 7 minutes long.

> [PLAY video clip](#) (7 minutes) - Ötzi the Ice Man inquiry stimulus¹

Here's a summary of the clip for your reference: A human corpse discovered in South Tyrol was initially thought to be the body of a mountain climber who had recently died. But the body proved to be 5300 years old. Ötzi had been murdered, and his body was mummified in the ice. From examining traces of pollen in his digestive tract, scientists were able to place the date of Ötzi's death at sometime in late spring or early summer. In his last two days, they found, he consumed three distinct meals and walked from an elevation of about 6,500 feet, down to the valley floor and then up into the mountains again, where he was found.

Slide 3 (optional – for interest only, to add contextual richness): Ötzi finally speaks!

Researchers have used CT scans to measure Ötzi's vocal tract and synthesised sounds that approximate the timbre of his voice. This is how they believe he would have pronounced his vowels:

> [PLAY 4-second audio clip](#): Ötzi finally speaks!²

[0:08]

Slide 4: ['Warming stripes' - The rise in average temperature]

Novelist and critic James Bradley has observed³ that the effects of climate change are uncovering creatures and artefacts that have long been buried under ice. He calls this phenomenon 'Anthropocene unburial'.

"Throughout the Arctic and subarctic," he says, "animals and artefacts buried for thousands of years are reappearing, liberated from their frozen graves by the rapid warming in the region."

In the Alps – as we saw with Ötzi – "bodies of people lost for [long periods] in the mountains are emerging from the ice as glaciers melt. In Australia, towns submerged for generations are resurfacing as dam levels fall due to drought and heat."

Bradley goes on to say --

Slide 5: As human time...

-- "As human time and geological time collapse into one another, the deep past is erupting into the present all around us with terrifying and uncanny consequences."

¹ Audio edited from 'An Ice-Cold Case', Radiolab podcast, 19/11/2013. <https://radiolab.org/podcast/ice-cold-case>

² Source: <https://www.smithsonianmag.com/smart-news/hear-recreated-voice-otzi-iceman-180960570/>

³ James Bradley, citing author Robert Macfarlane, Could bringing Neanderthals back to life save the environment? The idea is not quite science fiction. *The Guardian*, 27/04/2020. <https://www.theguardian.com/books/2020/apr/27/could-bringing-neanderthals-back-to-life-save-the-environment-the-idea-is-not-quite-science-fiction>

Discussion (5 mins):

Let's try to make sense of James Bradley's comment that the "deep past is erupting into the present". Can the past exist in the present?

Other writers have observed that "deep time has an uncanny ability to telescope into and out of everyday moments,"⁴ and that where ancient relics emerge, "we are haunted by a very material ghost."⁵

Is the past ghostlike? Are memories of the past like ghosts?

Can there be such a thing as a 'material ghost'?

[0:14]

Slide 6: Here by Richard McGuire (#1)

This is a double page spread from a remarkable graphic novel entitled *Here*, by Richard McGuire.

On every page of the book, we see a variation of the same picture: the corner of a room, viewed from a fixed vantage point, capturing a range of different moments and events.

Each scene is labelled with the year in which it took place, and there are also these inset images labelled with different years, transporting us to different times in the same space.

One critic who reviewed the book says that it's "a chronicle of life, with kaleidoscopic intrusions ... the past intruding upon the future or the future [intruding] upon the past."⁶

In an interview, the book's creator Richard McGuire says: "That simultaneousness actually feels close to how we think. If you stop and try to examine your thoughts, it's always a jumble of memories and projections. We are all zooming around in time in our heads."⁷

Slide 7: We're rarely in the present...

He goes on: "We're rarely in the present—we're more often anticipating events, or thinking back to a memory of yesterday or last week or our childhoods, and then suddenly jumping ahead again."

Discussion (5 mins):

Is it true that we're rarely in the present, and that we're usually preoccupied by memories, imaginings or plans for the future? (*Pair talk, reflecting on students' own experience*)

⁴ Ginn, F., Bastian, M., Farrier, D., and Kidwell, J. 'Introduction: Unexpected Encounters with Deep Time.' *Environmental Humanities* 10 (1) (2018): 213-25.

⁵ *ibid*, citing philosopher Nick Mansfield.

⁶ Sante, L., Richard McGuire's *Here*. *New York Times*, 12/10/2015. <https://www.nytimes.com/2015/10/18/books/review/richard-mcguires-here.html>

⁷ Shapton, L., Split Screens: An Interview with Richard McGuire. *The Paris Review*, 12/06/2015. <https://www.theparisreview.org/blog/2015/06/12/split-screens-an-interview-with-richard-mcguire/>

[0:20]

Slide 8: Subjectivity of experience

The passage of time seems to have a subjective quality: Elderly people often feel that time passes quicker for them now than it did when they were younger. And writer Diana Senechal says: “‘Time’ has an imaginary dimension, which is just as real and important as clocked time.”⁸

Discussion (5 mins):

How can we reconcile this subjective quality of time with its objective quality (according to which one second is formally measured by a certain number of oscillations of the caesium atom)?

[0:26]

Slide 9: What then is time? ...

We can probably all relate to St Augustine's comment: we know perfectly well what time is until we have to explain it. It turns out to be very tricky to put into words.

In the next part of our workshop we'll try to figure out what sort of thing time is.

Slide 10: Linear time

A common conception is that time is a straight line from the past to the future. This is what's called a 'linear' conception of time (which the ancient Greeks called *Chronos*).

We might notice that certain sequences of events always happen in the same order. For instance, when you stir milk into coffee, they mix. But the opposite sequence of events, stirring milk out of coffee, never occurs. Likewise, wood burns to ash, but ash never 'unburns' to wood, and shattered vases never repair themselves. This suggests that time has an arrow, or directional quality, that distinguishes the past from the future.

We can imagine time being symmetrical, meaning that the past and future would be mirror images of each other. But time's arrow suggests that time isn't like that. Instead, time is asymmetrical. (*This is related to the second law of thermodynamics, which states that entropy – the amount of disorder in a system – always increases.*)

Time's arrow is evident in various phenomena, such as causes always coming before (never after) their effects; and the fact that we can remember the past, but not the future.⁹ As Bertrand Russell said, “our wishes can affect the future but not the past, the future is to some extent subject to our power, while the past is unalterably fixed.”

Time and space are similar: they're both fundamental aspects of our experience, and they're both dimensions of existence that enable us to pinpoint the location of objects and events. But while time's arrow requires that causes always come before their effects, there is no 'space's arrow' that requires causes to come to the left or right of their effects.

⁸ How to Make Time. *Take Away the Takeaway*, 18/08/2023. <https://dianasenechal.wordpress.com/2023/08/18/how-to-make-time/>

⁹ Text adapted from Peterson, D., *Philosophy of Time: Time's Arrow*. *1000 Word Philosophy*. https://1000wordphilosophy.com/2023/07/17/times-arrow/#_ftn1

Discussion (3 mins):

Does it strike you as odd that time has this directional quality or asymmetry (particularly since space doesn't)?

[0:30]

Slide 11: River

Another metaphor people often use in describing linear time is that time is like a river: "[Time] moves like a great river, inexorably dragging us with it, and, in the end, washes us up on its shore while it continues, unstoppable. Time flows. It moves ever forwards."¹⁰

Discussion (9 mins):

What is the present? (Pair talk, and ask students to come up with a definition)

Is the present a moment?¹¹ Does it have a duration – or is it an instantaneous point between the past and the future with no duration at all?

If the present has a duration, how long does it last?

A few ideas, for your reference:

Some have suggested that the present moment is a tiny fraction of a second, e.g. the time it takes for a bolt of lightning to flash in the sky (0.0002 seconds). Some think of it as the shortest duration that a human being can perceive – or the shortest duration that any creature is capable of perceiving.

Arguably, "There's no amount of time so small that you can't conceptually 'zoom in' on it. Every interval is made up of smaller and smaller sub-intervals... The length of a moment is an undefinable quantity and an unsolvable problem."¹²

If the present has no duration, does that mean that the present doesn't really exist?

'[The] present is only the boundary between the [past and future], having neither extension nor duration.' Arthur Schopenhauer (1788 – 1860).

The Fletcher's Paradox: Zeno states that if everything is motionless at every (durationless) instant, and time is entirely composed of these instants, then the fletcher's arrow must be motionless in flight. During each frozen moment, the arrow cannot move at all, since it has no time in which to do it.

¹⁰ Higgins, C., 'There is no such thing as past or future': physicist Carlo Rovelli on changing how we think about time. *The Guardian*, 14/04/2018. <https://www.theguardian.com/books/2018/apr/14/carlo-rovelli-exploding-commonsense-notions-order-of-time-interview>

¹¹ Note: The word 'moment' derives from the Latin *momentum* and *movere* referring to 'that which moves; that which irrefutably vanishes'. It's an interval so brief it just barely 'moves the needle'. It's the blink of an eye; a snap of the fingers; an instant; an infinitely short space of time. The word 'moment' also has another meaning in English: it can refer to importance, weight, value, or consequence. For instance, we might refer to a 'defining moment' or a 'critical moment'. This relates to the ancient Greek concept of *Kairos*: the proper or opportune time for a decisive act.

¹² Natasha Frost, N., How Long Is a Moment? The physics, neuroscience, linguistics, and philosophy behind a little bit of time. *Atlas Obscura*, 6/02/2018. <https://www.atlasobscura.com/articles/moment-time-physics-philosophy-linguistics-neuroscience>

[0:39]

Further discussion (9 mins):

In the 2nd century AD, the Stoic philosopher Marcus Aurelius wrote: 'Remember that man lives only in the present, in this fleeting instant; all the rest of his life is either past and gone, or not yet revealed.'¹³

In a similar vein, the 19th century German philosopher Arthur Schopenhauer wrote: 'Past and future... are as empty and unreal as any dream.'¹⁴

Do you think that the present is more real than the past and future?

Can you remember the past as vividly as you experience the present moment?

Can you imagine the future as vividly as you experience the present moment?

Is our sense of how real something *feels* a good indicator of how real it truly *is*?

[0:48]

Slide 12: *Here* by Richard McGuire (#2)

Throughout the graphic novel *Here*, certain events seem to echo through time. In these pages from the book you can see various examples of similar things happening in the same space at different points in time, for example: people having clumsy accidents; soothing babies; pausing in contemplation; dancing; throwing costume parties; and having a rest.

Slide 13: "History doesn't repeat itself, but it rhymes."

It's often said that "history doesn't repeat itself, but it rhymes."¹⁵

Discussion (5 mins):

What do you think it means for history to 'rhyme'?

Is it true that history doesn't repeat itself but it rhymes?

.....

[0:53]

3 minute break

.....

¹³ Aurelius, M., *The Meditations* (c. 121 - 180 AD), III:10. (Edition and page reference not known.)

¹⁴ Schopenhauer, A. (1819), *The World as Will and Representation*. (Edition and page reference not known.)

¹⁵ The origin of this quote is unclear, but it is frequently attributed to Mark Twain.

[0:56]

Slide 14: Cyclical time

Many people have taken the view that history doesn't merely rhyme, but that it actually does repeat itself. This view of time might be called *cyclical*. Cyclical time repeats in an infinite loop.

Philosophers sometimes call this 'eternal return' or 'eternal recurrence'. The idea is that the same events will continue to occur in exactly the same way, over and over again, for eternity.

Cyclical time features heavily in the worldviews of various cultures, including in Maya and Inca mythologies.

The idea of an endlessly cycling 'Wheel of Time' is also represented in various Buddhist and Hindu practices and symbols.

Slide 15: Kalachakra

The Tibetan Buddhist 'Kalachakra', for instance, is a complex and intricate circular diagram symbolising cosmic cycles of existence which are divided into epochs of enlightenment and epochs of decline.

Both Buddhism and Hinduism conceive of an endless cycle of birth, death and rebirth in which all sentient beings are trapped until liberated by spiritual enlightenment...

Slide 16: Samsara

... This cycle, called *samsara*, is also frequently depicted as a wheel, with beings continuously born into different states of existence based on their karma.

A contemporary idea that corresponds with cyclical time is The Adaptive Cycle:

Slide 17: The Adaptive Cycle

This is a conceptual model that helps us understand the long-term dynamics of change in complex ecological and social systems. The Adaptive Cycle model makes sense of the cyclical changes in human affairs, such as an empire rising and falling, only for another empire to rise.

The Adaptive Cycle also helps us model cyclical changes in natural systems, for instance the slow cycles of glacial advance and retreat. Another example would be the cyclic transitions among terrestrial biomes, such as savanna shifting to grassland and back, or tundra changing into forest and back, over geological timescales.

Let's remember this Cyclical view of time, as well as the Linear view that we talked about earlier. We'll be doing a hands-on activity soon to help us think about these views of time. But first, I want to show you a little more of the graphic novel *Here*.

Slide 18: Reaching into the past. Here by Richard McGuire (#3)

On this page we can see what existed a century or more ago, on the site where the living room would one day stand. We see there was a stately home, a meadow, and a grazing cow.

Slide 19: Reaching into the past. Here by Richard McGuire (#4)

And here we see the modern-day house and living room being built.

Change is afoot on this piece of land, like everywhere else. Indeed, contemporary physicists describe the world as a whole as being “in a ceaseless process of change.”¹⁶ This is not a new idea: even before Socrates, Heraclitus said “Everything is in flux” and “Nothing endures but change.”

Aristotle explicitly related change to time, saying that time is the measure of change.

Discussion (6 mins):

If nothing were to change, would time itself cease to exist?

[1:06]

Slide 20: Reaching deeper into the past (Here by Richard McGuire (#5)

Here's another page from *Here*, in this instance reaching way back 10,000 years into the past, when the site was some kind of wetland.

A commentator has said: “[This] historical space precisely overlay[s] ... the corner of the room that has yet to be built... [Everything pictured on] the previous spreads does not yet exist. Yet of course it does. Or will, or has.”

Discussion (14 mins):

Does the future already exist? It is already there in some predetermined way, and we're just waiting for it to unfold for us?

[1:20]

Slide 21: 'Block' space-time (space-time exists as a single block)

Here's one last view of time to consider. According to the block universe theory, past, present, and future co-exist -- together with space -- as a single block of space-time.

Slide 22: 'Block' space-time (time as an illusion)

Someone who articulates this view with reference to the book *Here* is the critic Lucy Sante, who writes: “Maybe time is just an unavoidable experiential illusion. Maybe all those things [pictured on different pages of the book *Here*] ... are occurring ... simultaneously. [It's just that] we are only able to see one thing at a time in the same way that we are unable to see through walls.”¹⁷

Here's a scenario to help you understand this. Imagine a girl who has never seen a cat. She's looking through a narrow gap in a fence, and, on the other side, a cat walks by.

Slide 23: Fence with cat's head facing left

First she sees the head... and shortly afterwards, she sees the tail.

Slide 24: Fence with cat's tail

The cat turns round and walks back, and again the girl sees the head...

¹⁶ Rovelli, C. (2019), *The Order of Time*, Penguin.

¹⁷ Sante, L., Richard McGuire's *Here*. *New York Times*, 12/10/2015. <https://www.nytimes.com/2015/10/18/books/review/richard-mcguire-s-here.html>

Slide 25: Fence with cat's head facing right

... and a moment later, the tail.

Slide 26: Fence with cat's tail

This sequence begins to look like something regular and reliable. After seeing this sequence a number of times, the girl may well reason that the head *causes* the tail. Now, we know this is absurd. What the girl has failed to see is that the head and tail go together: they are all one cat. The trouble is, the girl was watching it through a narrow slit, and she couldn't see the whole cat at once.

I've adapted this from a scenario¹⁸ written by Alan Watts who uses it as a metaphor for our limited view of space-time. In everyday life, we are like the girl gazing through the gap in the fence: we can only see part of the picture, which is why we think that there are causes and effects. But according to the block universe theory, causes and effects are all part of the same unified entity: space-time.

Connecting back to our previous discussion about whether the future already exists, consider this:

Slide 27: If the block universe is the correct picture....

"If the block universe is the correct picture, even if we managed to travel backward in time, we could never do anything that would change the future... Because the future and the past already exist in the block, any action we take must already exist."¹⁹

Questions/clarification (2 mins)

[1:25]

Slide 28: 'Three circles' activity

Activity (15 mins):

Place three large non-intersecting circles on the floor (or wall), labelled with the printed headers 'linear', 'cyclical' and 'block', respectively.

Explain that you will be distributing various statements about time, and students will need to decide (if they can) which of the three views of time each statement is associated with.

Distribute printed slips of paper/card, each displaying one of the 14 statements listed below.

Allow a period of time for individual reflection or pair discussion. Then, ask students to read aloud each of their statements and place it in the appropriate circle, explaining their decision, particularly if it is contentious. Open to wider discussion if desired.

Note: the statements below are intentionally grouped in such a way that each column has a mix of 'linear', 'cyclical' and 'block' associations. (On the accompanying printable PDF, the statements are listed in random order, so you may wish to group them as follows prior to the workshop, then divide the students into two groups, and distribute one set of cards to each group.)

¹⁸ Watts, A. (1966), *The Book on the Taboo Against Knowing Who You Are*. p. 26-27.

¹⁹ Clegg, B. (2011). *Build Your Own Time Machine: The real science of time travel*.

Distribute to group 1:	Distribute to group 2:
For most of human history we have relied on circadian rhythms rather than cumulative measurements of time. We use time measurements that reflect the periodic movements of the earth and the moon. We recognise the recurrent return of the seasons.	<p>“A life has a beginning and an end.... time is bookended by two final points. Everything exists along a line with “before” at one end and “after” at the other.”</p> <p>– Jonny Thomson, philosopher and writer</p>
<p>“We live in a universe which has neither past nor future. A strange new world in which we are alive and dead in the same instant. In this eternal present, our sense of the passage of time is nothing more than a giant cosmic illusion.”</p> <p>– Steve Farrar, describing the views of theoretical physicist Julian Barbour</p>	<p>We have all some experience of a feeling, that comes over us occasionally, of what we are saying and doing having been said and done before, in a remote time — of our having been surrounded, dim ages ago, by the same faces, objects, and circumstances.”</p> <p>– Charles Dickens, writer</p>
<p>“I’m sick and tired of this block universe ... I don’t think that next Thursday has the same footing as this Thursday. The future does not exist. It does not! Ontologically, it’s not there.”</p> <p>– Avshalom Elitzur, physicist and philosopher</p>	<p>“A timeless universe is hard to imagine... Even when you try to imagine its absence, you sense it moving as your thoughts shift [and] your heart pumps blood to your brain.... time never seems to stop.”</p> <p>– Sara Walker, astrobiologist and theoretical physicist.</p>
<p>“If I observe the microscopic state of things, then the difference between past and future vanishes... in the elementary grammar of things, there is no distinction between ‘cause’ and ‘effect.’”</p> <p>– Carlo Rovelli, theoretical physicist</p>	<p>“‘The arc of the moral universe is long, but it bends towards justice’... [The] trajectory of history is imperceptible as we struggle through it; but rest assured its contours are there.”</p> <p>– Chris Hayes, political commentator</p>
<p>“There is only one day left, always starting over: It is given to us at dawn and taken away from us at dusk.”</p> <p>– Jean-Paul Sartre, philosopher</p>	<p>“The distinction between the past, present and future is only a stubbornly persistent illusion.”</p> <p>– Albert Einstein, theoretical physicist</p>
You can’t unscramble an egg.	<p>“Time is a flat circle.”</p> <p>– Friedrich Nietzsche, philosopher</p>
<p>“Time is unidirectional. We are born, we age, we die - in that order. Time is irreversible; we can’t travel back in time and we can’t know the future... Things fall apart... My hot cup of tea becomes cold, it doesn’t heat up. A dead body decays, it doesn’t come back to life. Cars wear out. And I’m ageing.”</p> <p>– Stephen Nash, historian of science and archaeologist</p>	<p>“The felt difference of quality between past and future... is not an intrinsic difference, but only a difference in relation to us: to impartial contemplation, it ceases to exist... Whoever wishes to see the world truly... must learn to overcome the difference in attitude towards past and future, and to survey the whole stream of time in one comprehensive vision.”</p> <p>– Bertrand Russell, philosopher</p>

[1:40] Thanks and conclude workshop

Optional additional segment:

Slide 31: [Terracotta shard]

This shard of Roman terracotta from the Roman Empire, dating back to the 2nd or 3rd century AD, was recently found in Andalucía, Spain. It was part of an amphora – a clay vessel filled with olive oil. What is remarkable about this fragment is that it's inscribed with words from *The Georgics*, a classic poem by Virgil.

Slide 32: [Terracotta shard with decrypted text]

Classicists have been able to decipher fragments of the poem, which invokes the gods Bacchus (God of Wine) and Ceres (Goddess of Agriculture), and describes the mythical invention of farming.

Reflecting on this artefact, culture writer Charlotte Higgins observed:

"There are moments when an ancient object emerges from the soil and seems, for a second, to close the gap between you and the deep and slumbering past. Then... the illusion of connection passes: one is left with the same old sensation ... of seeing a long-distant world indistinctly ... as if through a misted-up pane of glass."²⁰

Discussion:

Is there a gap between us and the past?

Can the discovery of ancient objects bridge that gap?

Are the present and past continuous or discontinuous?

Does the past continue to exist, or is it truly gone?

²⁰ Higgins, C., Why a piece of ancient pot and a scrap of Virgil's poetry speak to us down the ages. *The Guardian*, 24/06/2023. <https://www.theguardian.com/commentisfree/2023/jun/24/ancient-roman-pot-virgil-poetry>