

This document contains ideas for things for students to
'DISCUSS', 'RESEARCH' & 'DO'

DISCUSS: Use the following as prompts for discussions, or as the basis for discursive writing exercises.

1. “Living things are different. They are full of activity, always changing and constantly working hard to maintain themselves.” (p16)

- What are the main differences between living and non-living things?
- Think of a few examples for each.
- Where do wood, feathers, hair and teeth fit into this?

TO DIG DEEPER: what about viruses (like the one that causes Covid-19) – are they alive? What about ‘self-reproducing’ computer viruses?

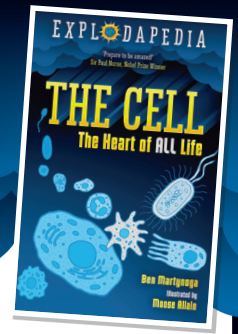
2. “Every single cell that’s alive today is connected to the same gigantic family tree. And Luca is the tiny seed that this entire family has grown from.” (p15)

All the cells on Earth today are descended from Luca. That means all people and all creatures living on the earth today are related.

- Did discovering this fact change the way you think about your relationships with the people and other living things around you?
- If everyone knew this fact about life, do you think it could help speed up action to stop the climate crisis and protect nature?

3. “All living things on this planet are based on cells” (p12) “... in the time it’s taken you to read this page, more than 100,000,000 of your red blood cells will have worn themselves out and died” (p107)

- If the cells that make up your body are constantly dying and being replaced, are you still the same person you were last week?
 - How about when you were born?
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4. “It was lucky, too, that Luca had found the perfect spot to hang out: a hydrothermal vent...” (p10)

- What ‘ingredients’ were needed in this vent, to create the first cell, Luca, and set it growing and dividing? (See p80-82)
- Why can’t scientists be certain that life started in a hydrothermal vent?

TO DIG DEEPER: do you think brand-new life forms could once again start taking shape in a deep-sea vent, or elsewhere, today? What might happen to them if they did?

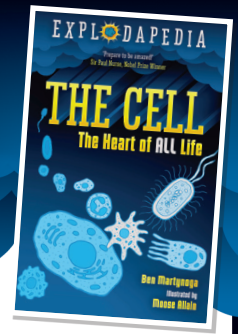
5. “Flatworms have far more stem cells than humans...and each one of those stem cells has the power to make every cell in the worm’s whole body.” (p127)

Imagine humans had the same regeneration ‘superpowers’ as flatworms.

- Would it change your daily life?
- Would our bodies still grow old?
- What problems might arise if people were ‘cloning’ themselves all the time?
- Can you think of any reasons why human bodies haven’t evolved the ability to regenerate themselves as well as flatworms?

6. About 2.4 billion years ago bacteria cells nearly wiped out all life on Earth, during the ‘Great Oxygen Catastrophe’ (p90-92)

- How did those bacteria cause such havoc?
- What happened to the planet’s climate?
- How does the Great Oxygen Catastrophe compare to the way humans are altering the atmosphere today?
- Could bacteria have ‘decided’ to stop harming their world? Can the same be said of us humans?



RESEARCH: The following topics are covered in the book, but they are complex areas, with big implications for all our lives. You could use these as prompts for projects that take a deeper dive.

1. “All multicellular bodies contain stem cells – cells that haven’t differentiated” (p125)

Stem cells are cells that haven’t yet committed to performing a particular function – e.g. making skin, bone, brain etc.

Scientists are developing ways of ‘re-programming’ stem cells – manipulating them so that they differentiate into different kinds of cells.

- How could these cells be used to heal damage to our bodies?
- What are the possible risks doctors need to avoid if they want to inject stem cells into our bodies?
- Have patients already received stem cell treatments? For which health conditions?
- Could stem cells provide a never-ending supply of new cells and body parts that could stop our bodies ageing?
- Could humans ever become immortal?

SOME POSSIBLE RESOURCES THAT MIGHT GET YOU STARTED:

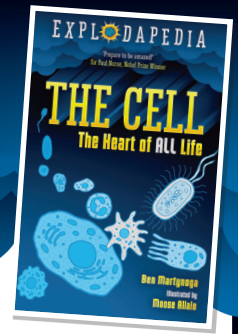
<https://www.theguardian.com/film/2021/nov/03/this-is-such-an-important-moment-how-stem-cell-research-is-transforming-medicine>

<https://www.bbc.co.uk/bitesize/guides/z24vw6f/revision/6>

2. “...if we can use other cells to put things right, we could make this planet a more hospitable place for all sorts of living things.” (p135)

‘Synthetic biology’ is a new way of manipulating cells that could be used to help tackle climate change and many of the other big, global challenges facing humanity. Look at the examples below and research them further (the linked articles are just to get you started).

- **Cells instead of fossil fuels:** carbon neutral fuels; bioplastics
<https://thebiologist.rsb.org.uk/biologist-features/algal-biofuel-in-bloom-or-dead-in-the-water>
- **Cells to help feed the world:** making plants that grow more efficiently; stem cells from a cow to make burgers...
<https://www.gatesnotes.com/Tuning-up-photosynthesis-to-feed-the-world>
<https://gfi.org/science/the-science-of-cultivated-meat/>
- **Cells against plastic:** rejigging enzymes from bacteria which could eat our waste
<https://www.forbes.com/sites/scottercarpenter/2021/03/01/the-race-to-develop-plastic-eating-bacteria/>



- **Cells to tackle the climate crisis:** enhancing green plants to photosynthesize more efficiently to suck carbon dioxide emissions from the air
<https://www.nationalgeographic.com/environment/article/can-we-hack-plant-dna-to-suck-up-more-carbon-emissions>

YOUR MISSION IS TO USE CELLS TO MAKE LIFE BETTER FOR HUMANS AND THE REST OF THE LIVING WORLD. BASED ON YOUR RESEARCH, FORMULATE YOUR OWN PERSONAL ACTION PLAN. Remember to think about any potential risks or things that could go wrong with the cell-based solutions you've chosen.

3. “All the food we eat is made by other living things” (p144)

Think about the main ways humans rely on other cell-based life forms. What would happen if your body's 'microbiome' suddenly disappeared? (see p119-21)

Once you've done some research, here's your challenge:

Imagine it's 2040 and you're part of a team planning a permanent human base on Mars.

- To succeed, will your mission need to take other creatures and cells with them?
- Which would be most important and why?
- How would the Mars colonists keep them alive?

HERE'S A SOURCE TO GET YOUR PLAN STARTED:

<https://astronomy.com/news/2017/05/could-we-live-on-mars>

4. “Across the world, people have long grown up listening to all kinds of traditional stories about how life on Earth got started.” (p53)

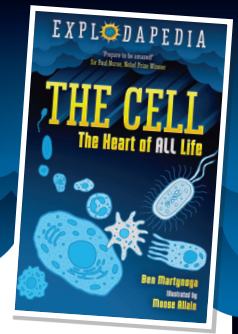
Our brains struggle to imagine things not having a beginning. When we get to the edge of our knowledge, we may look to some kind of belief or religion to explain how life got started.

READ ABOUT the creation beliefs of the Hawaiians, the Kuba people of Central Africa or those of other religions or Indigenous Peoples, past or present.

How do these traditional creation stories differ from scientific theories about the origin of life?

Another creation theory is 'spontaneous generation' (see p54).

- Why do you think the author calls this a 'zombie' theory?
- As an explanation, is it more similar to the traditional creation stories or a scientific theory?



DO:

The following are prompts for activities or exercises that students could tackle, individually or in groups.

1. “During the first two billion years, different waves of life forms rose and fell. Like hordes of tiny artists ... they changed the colour scheme of the entire planet several times over.” (p85)

Have a look at pages 85-94 and the descriptions of what the world – especially the sea – looked like through millions of years.

See also the timelines at the end of the book (p148).

Make a storyboard with coloured and annotated pictures showing this timeline up to the present day.

Here are the headings for each picture:

1. The Orange and Green Planet (4.5–3.4 billion years ago)
2. The Purple Planet (~3.4–2.5 billion years ago)
3. A Splash of Blood Red (~2.6–2.4 billion years ago)
4. The Ice-White, Nearly Dead Snowball Planet (~2.4–2.1 billion years ago)
5. The Boring, Stinking Sludge-Black Planet (~2.1–0.8 billion years ago)
6. The Green and Pleasant Planet Today

Think about the whole, huge sweep of human history – pyramids, castles, the Stone Age etc – can you even see it on your storyboard? How does that make you feel?

TO DIG DEEPER: Are microbes still having as big an effect on our planet today as they have done in the past?

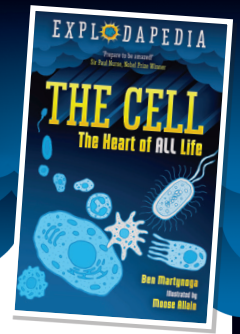
2. “The hero is a single cell. Now, this cell couldn’t really have had a name and wasn’t male or female, but let’s call it Luca.” (p7)

Luca is depicted in the book as a cartoon character. What do you think about the way the author has given this cell a voice and a personality? Was this a useful device?

Have a go at designing your own ‘cell character’. What shape would it be? What ‘superpowers’ might it have? Would it work alone, or with other cells (eg. as part of a body or swarm)? What kind of personality might it have?

3. “Planet Earth was young and grumpy.” (p7)

Paint or draw a picture of how you imagine the earth looked four billion years ago.



FURTHER READING

- *Explodapedia: The Gene* by Ben Martynoga & Moose Allain
- *What is Life?* by Paul Nurse
- *The Song of the Cell* by Siddhartha Mukherjee
- **BBC Bitesize: Cell Biology** <https://www.bbc.co.uk/bitesize/guides/z2s83k7/revision/1>
- Look out for the next titles in the series:
EXPLODAPEDIA: EVOLUTION, REWILD, THE BRAIN and THE VIRUS are all coming soon